U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

NUREG-1437
Supplement 7a
Second Renewal

Site-Specific Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 7a, Second Renewal

Regarding Subsequent License Renewal for North Anna Power Station Units 1 and 2

Draft Report for Comment

Office of Nuclear Material Safety and Safeguards

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Second Renewal

Site-Specific Environmental Impact Statement for License Renewal of Nuclear Plants

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Regarding Subsequent License Renewal for North Anna Power Station Units 1 and 2

Draft Report for Comment

Manuscript Completed: December 2023
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Office of Nuclear Material Safety and Safeguards

Proposed Action	Issuance of renewed facility operating licenses NPF-4 and NPF-7 for North Anna Nuclear Power Station, Units 1 and 2, in Louisa County, Virginia
Type of Statement	Draft Supplemental Environmental Impact Statement
Agency Contact	Tam Tran U.S. Nuclear Regulatory Commission (NRC) Office of Nuclear Material Safety and Safeguards Mail Stop T-4B72 Washington, DC 20555-0001 Email: tam.tran@nrc.gov

Comments:

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This site-specific EIS supersedes NUREG-1437, Supplement 7, Second Renewal, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 7, Second Renewal, Regarding Subsequent License Renewal for North Anna Power Station Units 1 and 2, Draft Report for Comment," published in August 2021.

COVER SHEET

Responsible Agency: U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards.

Title: Site-Specific Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, NUREG-1437, Supplement 7a, Second Renewal, Draft Report for Comment.

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ABSTRACT

The U.S. Nuclear Regulatory Commission (NRC) has prepared this site-specific environmental impact statement (EIS) as part of its environmental review of Dominion Energy Virginia's (Dominion) application for subsequent renewal of the operating licenses for North Anna Power Station, Units 1 and 2 (North Anna) for an additional 20 years. This EIS includes the site-specific evaluation of the environmental impacts of the proposed action (North Anna subsequent license renewal (SLR)), and alternatives to SLR. As alternatives, the NRC considered (1) new nuclear (small modular reactor) generation, (2) a combination of solar photovoltaic, offshore wind, small modular reactor, and demand-side management, and (3) no action.

This site-specific EIS considers information contained in Dominion's September 28, 2022, submittal (Agencywide Documents Access and Management System No. ML22272A041, VEPCO 2022-TN8270), which supplements its August 24, 2020, SLR application (VEPCO 2020-TN8383). Previously, in August 2021, the NRC issued *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, Supplement 7, Second Renewal, Regarding Subsequent License Renewal for North Anna Power Station Units 1 and 2, Draft Report for Comment (NUREG-1437, Supplement 7, Second Renewal) (DSEIS) (NRC 2021-TN7294). The 2021 DSEIS considered the impacts of license renewal according to the categories established in NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, Revision 1, Final Report (NUREG-1437) (LR GEIS) (NRC 2013-TN2654) and Table B–1 in Appendix B to Subpart A of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51 (TN250): Category 1 issues (generic to all or a distinct subset of nuclear power plants and Category 2 issues (specific to individual nuclear power plants). For the 51 Category 1 issues applicable to North Anna SLR, the 2021 DSEIS found no new and significant information concerning any of these issues that would change the conclusions of the 2013 LR GEIS. The LR GEIS's conclusions of SMALL impact was adopted for those issues in the 2021 DSEIS. For 12 Category 2 issues applicable to North Anna SLR, the 2021 DSEIS evaluated each of those issues on a site-specific basis and made site-specific findings of SMALL, MODERATE, or LARGE impact.

In February 2022, the Commission issued three memoranda and orders, Commission Legal Issuance (CLI)-22-02, CLI-22-03, and CLI-22-04 (NRC 2022-TN8182, NRC 2022-TN8272, NRC 2022-TN9553), concerning SLR environmental reviews. In CLI-22-02, the Commission found that the LR GEIS did not address SLR and that 10 CFR 51.53(c)(3)(TN250) does not apply to SLR applications and, therefore, the NRC may not rely on the 2013 GEIS and Table B–1 for the evaluation of Category 1 issues for SLR. In its decisions, the Commission determined that the NRC staff must address these Category 1 issues on a site-specific basis in site-specific EISs, unless the SLR applicant elects to await the issuance of a revised GEIS and rule.

On November 15, 2022, following Dominion's submittal of its site-specific environmental report supplement (VEPCO 2022-TN8270), the NRC staff issued a notice (87 FR 68522-TN8588) of the staff's intent to conduct a site-specific evaluation and to publish a site-specific EIS for North Anna SLR.

Consistent with the notice in 87 FR 68522, the NRC staff has prepared this site-specific EIS, which considers the impacts of all SLR issues applicable to North Anna SLR on a site-specific basis. In sum, this EIS (1) addresses, on a site-specific basis, the issues that were previously treated as generic "Category 1" issues in the 2021 DSEIS, and (2) updates and revises the evaluation of site-specific "Category 2" issues in the 2021 DSEIS.

Based on the NRC staff's site-specific evaluation of environmental impacts, the staff's preliminary recommendation is that the adverse environmental impacts of North Anna SLR are not so great that preserving the option of SLR for energy-planning decision-makers would be unreasonable. The NRC staff based its preliminary recommendation on the following:

- Dominion's environmental report, as supplemented
- the NRC staff's consultations with Federal, State, Tribal, and local agencies
- the NRC staff's independent environmental review
- consideration of public comments received during two scoping periods and comments received on the DSEIS

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EXECUTIVE SUMMARY

Background

By letter dated August 24, 2020, Virginia Electric and Power Company, doing business as Dominion Energy Virginia (Dominion), submitted to the U. S. Nuclear Regulatory Commission (NRC) an application requesting subsequent license renewal (SLR) for the North Anna Power Station, Units 1 and 2 (North Anna), renewed facility operating licenses (Agencywide Documents Access and Management System [ADAMS] No. ML20246G703, (VEPCO 2020-TN8383). Dominion's application included an environmental report (ER) (Agencywide Documents Access and Management System (ADAMS) No. ML20246G698) (TN8099). Dominion subsequently submitted additional information, and supplemented its application with a site-specific supplement to its ER (ML22272A041) (TN8270), as listed in this EIS, Appendix D. The North Anna, Unit 1 renewed facility operating license (NPF-4) expires at midnight on April 1, 2038; the North Anna, Unit 2 renewed facility operating license (NPF-7) expires at midnight on August 21, 2040. In its application, Dominion requested renewed facility operating licenses for a period of 20 years beyond these expiration dates; that is, to April 1, 2058, for North Anna, Unit 1, and August 21, 2060, for North Anna, Unit 2.

The NRC's environmental protection regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51 (TN250), "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," implement the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.; TN661). This Act is commonly referred to as NEPA. The regulations at 10 CFR Part 51 require the NRC to prepare an environmental impact statement (EIS) before deciding whether to issue an operating license or a renewed operating license for a nuclear power plant. Pursuant to these regulations, the staff performed an environmental review of Dominion's SLR application and prepared a supplement to *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, Revision 1, Final Report (NUREG-1437) (LR GEIS) (NRC 2013-TN2654). In August 2021, the NRC issued the supplement as a draft for public comment, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, Supplement 7, Second Renewal, Regarding Subsequent License Renewal for North Anna Power Station Units 1 and 2, Draft Report for Comment (NUREG-1437, Supplement 7, Second Renewal) (DSEIS) (NRC 2021-TN7294). The DSEIS evaluated the impacts of license renewal issues determined to be site-specific (Category 2) in the LR GEIS on a site-specific basis. For license renewal issues determined to be generic (Category 1) issues in the LR GEIS, the DSEIS adopted the LR GEIS's findings.

The NRC received public comments on the DSEIS; these comments are addressed in Appendix A.2, "Comments Received on the North Anna Power Station, Units 1 and 2 DSEIS Environmental Review," in this EIS. The NRC staff was preparing to address those comments in a Final Supplemental Environmental Impact Statement (FSEIS). However, on February 24, 2022, before the NRC issued the FSEIS, the NRC Commission issued three memoranda and orders that addressed SLR proceedings for five nuclear power plant SLR applications. Two of these orders, Commission Legal Issuance (CLI)-22-02 (NRC 2022-TN8182) and CLI-22-03 (NRC 2022-TN8272), are relevant to the North Anna SLR environmental review. In those orders, the Commission concluded that the LR GEIS, which the NRC staff relies on in part to meet its obligations under 10 CFR Part 51 and NEPA, did not consider the impacts from operation during the SLR period of extended operations (PEO). Therefore, the Commission determined that the NEPA reviews for the affected nuclear power plants, including North Anna, were inadequate.

In CLI-22-03, the Commission directed the NRC staff to review and update the LR GEIS so that it covers nuclear power plant operation during the SLR PEO. The Commission stated that the most efficient way to proceed would be for the NRC staff to review and update the LR GEIS and then take appropriate action with respect to pending SLR applications to ensure that the environmental impacts of SLR are considered. However, the Commission afforded SLR applicants an opportunity to submit a revised ER, providing a site-specific evaluation of environmental impacts during the SLR PEO. In such a submittal, SLR applicants must evaluate, on a site-specific basis, the impacts of environmental issues that were dispositioned in the LR GEIS and Table B–1 in Appendix B to Subpart A of 10 CFR Part 51 as generic (Category 1) issues. The NRC staff would then address the impacts of these issues during the SLR PEO in site-specific EISs.

On September 28, 2022, Dominion submitted a supplement to its ER, in which it presented a site-specific environmental review of the impacts of continued operations of North Anna during the SLR period for those environmental issues for which Dominion had previously relied on the LR GEIS's generic findings in its ER (VEPCO 2022-TN8270). That review addressed on a site-specific basis each environmental issue that had been previously dispositioned as a Category 1 issue in the 2013 LR GEIS and Dominion's ER.

This EIS considers the impacts of all subsequent license renewal issues applicable to North Anna SLR on a site-specific basis, including the site-specific issues considered in the August 2021 DSEIS as well as the issues that had been treated as generic Category 1 issues in the August 2021 DSEIS. This EIS considers information in Dominion's SLR application, as supplemented; Dominion's September 28, 2022, submittal; the staff's consultation with Federal, State, Tribal, and local government agencies; and other new information, as appropriate. In addition, Appendix A.2 of this EIS presents the comments that the NRC staff received on the DSEIS and the staff's responses thereto. The NRC staff considered those comments, as appropriate, in the discussions and analyses contained in this draft EIS. Thus, this EIS supersedes the August 2021 DSEIS.

Proposed Action

The proposed Federal action (renewal of the North Anna operating licenses) was initiated by Dominion upon submitting its SLR application. The current North Anna operating licenses are set to expire at midnight on April 1, 2038, for Unit 1 (NPF-4) and August 21, 2040, for Unit 2 (NPF-7). The NRC's Federal action is to determine whether to renew the North Anna operating licenses for an additional 20 years of reactor operation. If the NRC renews the operating licenses, Dominion would be authorized to operate until April 1, 2058 (Unit 1), and August 21, 2060 (Unit 2).

Purpose and Need for the Proposed Federal Action

The purpose and need for the proposed action (renewal of the North Anna operating licenses) is to provide an option that allows for power generation capability beyond the term of the current renewed nuclear power plant operating licenses to meet future system generating needs, as such needs may be determined by energy-planning decision-makers such as State regulators, utility owners, and, where authorized, Federal agencies (other than the NRC). The definition of purpose and need reflects the NRC's recognition that, absent findings in the safety review required by the Atomic Energy Act of 1954, as amended, or in the NEPA environmental analysis that would lead the NRC to reject an SLR application, the NRC has no role in the energy-planning decisions of utility officials and State regulators as to whether a particular nuclear power plant should continue to operate.

Environmental Impacts of Subsequent License Renewal

This site-specific EIS evaluates the potential environmental impacts of the proposed action and reasonable alternatives to that action. The NRC designates the environmental impacts from the proposed action and reasonable alternatives as SMALL, MODERATE, or LARGE. These designations are described below:

SMALL: Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE: Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE: Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

In this EIS, the NRC staff evaluates 65 environmental issues applicable to North Anna SLR. Table B–1 in Appendix B to Subpart A of 10 CFR Part 51 and the LR GEIS address 51 of these issues as “generic” or “Category 1” issues. In the 2021 DSEIS, the NRC relied upon the analysis and conclusions in the 2013 LR GEIS for each of those generic (category 1) issues. The NRC staff determined that there would be no impacts related to these issues beyond those already discussed in the GEIS. For each of those issues, the staff adopted the LR GEIS’s conclusions of “SMALL.” However, as explained under “Background,” the Commission has determined that the staff cannot rely on the LR GEIS for SLR reviews. Therefore, in this EIS, the NRC staff addresses each of these 51 “generic” environmental issues on a site-specific basis.

In the 2021 DSEIS, additional environmental issues were evaluated on a site-specific basis. Table B–1 in Appendix B to Subpart A of 10 CFR Part 51 and the LR GEIS address these issues as “site-specific” or “Category 2” issues. In the 2021 DSEIS, the NRC staff performed site-specific analyses and made site-specific findings of SMALL, MODERATE, or LARGE for each of these issues. This site-specific EIS includes the NRC staff’s original site-specific analyses from the DSEIS, with certain updates and revisions (based, in part, upon comments received on the DSEIS), as appropriate.

Table ES-1 lists 65 environmental issues applicable to North Anna SLR and the NRC staff’s findings related to these issues. The issues that are denoted with a Footnote “(a)” identify those issues that were formerly addressed in the 2021 DSEIS as Category 1 issues.

Table ES-1 Summary of Site-Specific Conclusions Regarding North Anna Power Station Subsequent License Renewal

Resource Area	Environmental Issue	Impacts
Land Use	Onsite land use[a]	SMALL
Land Use	Offsite land use[a]	SMALL
Visual Resources	Aesthetic impacts[a]	SMALL

Table ES-1 Summary of Site-Specific Conclusions Regarding North Anna Power Station Subsequent License Renewal (Continued)

Resource Area	Environmental Issue	Impacts
Air Quality	Air quality impacts (all plants)[a]	SMALL
Air Quality	Air quality effects of transmission lines[a]	SMALL
Noise	Noise impacts[a]	SMALL
Geologic Environment	Geology and soils[a]	SMALL
Surface Water Resources	Surface water use and quality (non-cooling system impacts)[a]	SMALL
Surface Water Resources	Altered current patterns at intake and discharge structures[a]	SMALL
Surface Water Resources	Altered thermal stratification of lakes	SMALL
Surface Water Resources	Scouring caused by discharged cooling water[a]	SMALL
Surface Water Resources	Discharge of metals in cooling system effluent[a]	SMALL
Surface Water Resources	Discharge of biocides, sanitary wastes, and minor chemical spills[a]	SMALL
Surface Water Resources	Surface water use conflicts (plants with once-through cooling systems)[a]	SMALL
Surface Water Resources	Effects of dredging on surface water quality[a]	SMALL
Surface Water Resources	Temperature effects on sediment transport capacity[a]	SMALL
Groundwater Resources	Groundwater contamination and use (non-cooling system impacts)[a]	SMALL
Groundwater Resources	Groundwater use conflicts (plants that withdraw less than 100 gallons per minute [gpm])[a]	SMALL
Groundwater Resources	Radionuclides released to groundwater	SMALL
Terrestrial Resources	Effects on terrestrial resources (non-cooling system impacts)	SMALL
Terrestrial Resources	Exposure of terrestrial organisms to radionuclides[a]	SMALL
Terrestrial Resources	Cooling system impacts on terrestrial resources (plants with once-through cooling systems or cooling ponds)[a]	SMALL
Terrestrial Resources	Bird collisions with plant structures and transmission lines[a]	SMALL
Terrestrial Resources	Transmission line right-of-way (ROW) management impacts on terrestrial resources[a]	SMALL
Terrestrial Resources	Electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)[a]	SMALL
Aquatic Resources	Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds)	SMALL

Table ES-1 Summary of Site-Specific Conclusions Regarding North Anna Power Station Subsequent License Renewal (Continued)

Resource Area	Environmental Issue	Impacts
Aquatic Resources	Entrainment of phytoplankton and zooplankton (all plants)[a]	SMALL
Aquatic Resources	Thermal impacts on aquatic organisms (plants with once-through cooling systems or cooling ponds)	SMALL
Aquatic Resources	Infrequently reported thermal impacts (all plants)[a]	SMALL
Aquatic Resources	Effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication[a]	SMALL
Aquatic Resources	Effects of non-radiological contaminants on aquatic organisms[a]	SMALL
Aquatic Resources	Exposure of aquatic organisms to radionuclides[a]	SMALL
Aquatic Resources	Effects of dredging on aquatic resources[a]	SMALL
Aquatic Resources	Effects on aquatic resources (non-cooling system impacts)[a]	SMALL
Aquatic Resources	Impacts of transmission line right-of-way (ROW) management on aquatic resources[a]	SMALL
Aquatic Resources	Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses[a]	SMALL
Special Status Species and Habitats	Threatened, endangered, and protected species and essential fish habitat	May affect but is not likely to adversely affect the northern long-eared bat, tricolored bat, and monarch butterfly; no effect on essential fish habitat; no effect on sanctuary resources of National Marine Sanctuaries
Historic and Cultural Resources	Historic and cultural resources	Would not adversely affect known historic properties
Socioeconomics	Employment and income, recreation, and tourism[a]	SMALL
Socioeconomics	Tax revenues[a]	SMALL
Socioeconomics	Community services and education[a]	SMALL
Socioeconomics	Population and housing[a]	SMALL
Socioeconomics	Transportation[a]	SMALL
Human Health	Radiation exposures to the public[a]	SMALL
Human Health	Radiation exposures to plant workers[a]	SMALL
Human Health	Human health impact from chemicals[a]	SMALL
Human Health	Microbiological hazards to the public (plants with cooling ponds or canals or cooling towers that discharge to a river)	SMALL
Human Health	Microbiological hazards to plant workers[a]	SMALL

Table ES-1 Summary of Site-Specific Conclusions Regarding North Anna Power Station Subsequent License Renewal (Continued)

Resource Area	Environmental Issue	Impacts
Human Health	Chronic effects of electromagnetic fields (EMFs)	Uncertain impact
Human Health	Physical occupational hazards[a]	SMALL
Human Health	Electric shock hazards	SMALL
Postulated Accidents	Design-basis accidents[a]	SMALL
Postulated Accidents	Severe accidents	See EIS Appendix F
Environmental Justice	Minority and low-income populations	No disproportionate and adverse human health and environmental effects on minority and low-income populations
Waste Management	Low-level waste storage and disposal[a]	SMALL
Waste Management	Onsite storage of spent nuclear fuel[a]	SMALL
Waste Management	Offsite radiological impacts of spent nuclear fuel and high-level waste disposal[a]	[b]
Waste Management	Mixed-waste storage and disposal[a]	SMALL
Waste Management	Nonradioactive waste storage and disposal[a]	SMALL
Cumulative Impacts	Cumulative impacts	See EIS Section 3.15
Uranium Fuel Cycle	Offsite radiological impacts—individual impacts from other than the disposal of spent fuel and high-level waste[a]	SMALL
Uranium Fuel Cycle	Offsite radiological impacts—collective impacts from other than the disposal of spent fuel and high-level waste[a]	[c]
Uranium Fuel Cycle	Nonradiological impacts of the uranium fuel cycle[a]	SMALL
Uranium Fuel Cycle	Transportation[a]	SMALL
Termination of Plant Operations and Decommissioning	Termination of plant operations and decommissioning	SMALL

Note: gpm = gallons per minute; ROW = right-of-way; SAMA = severe accidents.

(a) Dispositioned as generic (Category 1) for initial license renewal of nuclear power plants in Table B–1 in Appendix B to Subpart A of Title 10 CFR Part 51 (TN250).

(b) The ultimate disposal of spent fuel in a potential future geologic repository is a separate and independent licensing action that is outside the regulatory scope of this site-specific review. Per 10 CFR Part 51 (TN250) Subpart A the Commission concludes that the impacts presented in NUREG-2157 (NRC 2014-TN4117) would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 (TN4878) should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent nuclear fuel and high-level waste disposal, this issue is considered generic to all nuclear power plants and does not warrant a site-specific analysis.

(c) There are no regulatory limits applicable to collective doses to the general public from fuel cycle facilities. The practice of estimating health effects on the basis of collective doses may not be meaningful. All fuel cycle facilities are designed and operated to meet the applicable regulatory limits and standards. As stated in the 2013 GEIS, "The Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated." (10 CFR Part 54; TN4878) (Section 3.13.3.3 of this EIS).

Alternatives

As part of its environmental review of SLR applications, the NRC staff is required to consider alternatives to SLR and evaluate the environmental impacts associated with each alternative. These alternatives can include other methods of power generation (replacement energy alternatives), as well as simply not renewing the North Anna operating licenses (no-action alternative).

In total, the NRC staff considered 16 alternatives to the proposed action and eliminated 14 from detailed study due to technical, resource availability, or commercial limitations that are likely to exist when the North Anna operating licenses expire. Two replacement energy alternatives were determined to be commercially viable, and include:

1. new nuclear (small modular reactor [SMR]) alternative
2. combination alternative of solar photovoltaic, offshore wind, new nuclear (SMR), and demand-side management

These alternatives, along with the no-action alternative, were evaluated in detail in this EIS. In addition, the NRC staff also evaluated new and significant information that could alter the conclusions of the severe accident mitigation alternatives (SAMA) analysis previously performed for the North Anna initial license renewal in 2003, which authorized continued reactor operation for an additional 20 years beyond the original 40-year operating license term.

Preliminary Recommendation

The NRC staff's preliminary recommendation is that the adverse environmental impacts of North Anna SLR are not so great that preserving the option of SLR for energy planning decision-makers would be unreasonable. The NRC staff based its preliminary recommendation on the following:

- Dominion's ER, as supplemented
- the NRC staff's consultations with Federal, State, Tribal, and local agencies
- the NRC staff's independent environmental review
- the consideration of public comments received during two scoping periods and comments received on the 2021 DSEIS

ABBREVIATIONS AND ACRONYMS

$	$ dollar(s) (U.S.)
§	Section
°C	degree(s) Celsius
°F	degree(s) Fahrenheit
μm	micrometer
%	percent
AADT	average annual daily traffic
ac	acre(s)
ADAMS	Agencywide Documents Access and Management System
AEA	Atomic Energy Act of 1954 (as amended)
ALARA	as low as reasonably achievable
AOI	area of influence
APE	area of potential effect
ASLB	Atomic Safety and Licensing Board
BEIR	Biologic Effects of Ionizing Radiation
BMP	best management practice(s)
BOEM	Bureau of Ocean Energy Management
BTA	best technology available
Btu	British thermal unit
BTU/ft^3	British thermal unit(s) per cubic foot
CAA	Clean Air Act, as amended through 1990
CDC	Centers for Disease Control and Prevention
CDF	core damage frequency
CEQ	Council on Environmental Quality
CFR	*Code of Federal Regulations*
cfs	cubic feet per second
CLB	current licensing basis/bases
cm	centimeter(s)
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COL	combined license
CPUE	catch per unit effort
CVSZ	central Virginia seismic zone
CWA	Clean Water Act (Federal Water Pollution Control Act)

CZMA	Coastal Zone Management Act
dB	decibel(s)
dBA	A-weighted decibels
DHR	Department of Historic Resources (Virginia)
DOE	U.S. Department of Energy
Dominion	Virginia Electric and Power Company or Dominion Energy Virginia
DSEIS	draft supplemental environmental impact statement
EDG	emergency diesel generator
EFH	essential fish habitat
EIA	Energy Information Administration
EIS	environmental impact statement
EMF	electromagnetic field
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ER	environmental report
ESA	Endangered Species Act
ESP	early site permit
FEMA	Federal Emergency Management Agency
fps	feet per second
FR	*Federal Register*
FRN	*Federal Register* notice
ft	feet
ft^3	cubic feet
ft^2	feet squared
ft/min	feet per minute
FSEIS	final supplemental environmental impact statement
FWIS	Fish and Wildlife Information Service (Virginia)
FWS	U.S. Fish and Wildlife Service
g	gram(s)
g	acceleration due to gravity on the surface of the Earth
gal	gallons
GEIS	generic environmental impact statement
GHG	greenhouse gas
gpd	gallons per day
gpm	gallons per minute
gpy	gallons per year
GWd/MTU	gigawatt days per metric ton

GWh	gigawatt hour(s)
GWP	global warming potential
GWPP	Groundwater Protection Program
ha	hectare(s)
HDR	HDR Engineering, Inc.
ICRP	International Commission on Radiation Protection
in.	inch(es)
IPaC	Information for Planning and Consultation
IPE	individual plant examination
IPEEE	individual plant examination of external events
ISFSI	independent spent fuel storage installation
Juv	juvenile
km	kilometer(s)
kV	kilovolt
kW	kilowatt(s)
kWh/m^2/day	kilowatt-hour per square meter per day
L	liter(s)
lb	pound(s)
LERF	large early release frequency
LLRW	low-level radioactive waste
LR	license renewal
LR GEIS	NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*
m	meters
m/s	meter(s) per second
m^3	cubic meter(s)
m^3/min	cubic meters per minute
m^3/s	cubic meters per second
mgd	million gallons per day
mgy	million gallons of water per year
mi	mile(s)
mL	milliliter(s)
mLd	million liters per day
mm	millimeters
MMBtu	million British thermal units

MMPA	Marine Mammal Protection Act
mph	miles per hour
mrad	milliradiation absorbed dose
mrem	millirem
MSA	Magnuson–Stevens Fishery Conservation and Management Act
msl	mean sea level
mSv	millisievert
MUR	measurement uncertainty recapture
MW	megawatt(s)
MWd/MTU	megawatt days per metric ton uranium
MWe	megawatts electric
MWt	megawatts thermal
NAAQS	National Ambient Air Quality Standards
NAVD88	North American Vertical Datum of 1988
NCDC	National Climatic Data Center
NCEI	National Centers for Environmental Information
NCES	National Center for Education Statistics
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act
NESC	National Electrical Safety Code
NHPA	National Historic Preservation Act
NIEHS	National Institute of Environmental Health Sciences
NMFS	National Marine Fisheries Service
NMSA	National Marine Sanctuaries Act
NOAA	National Oceanic and Atmospheric Administration
North Anna	North Anna Power Station, Units 1 and 2
NOx	nitrogen oxide
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRC	U.S. Nuclear Regulatory Commission
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NRR	Nuclear Reactor Regulation, Office of (NRC)
O_3	ozone
ODCM	Offsite Dose Calculation Manual
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
oz	ounce

Pb	lead
PCB	polychlorinated biphenyl
pCi/l	picoCuries per liter
PAM	primary amebic meningoencephalitis
PDA	personnel decontamination area
PEO	period of extended operations
PL	Public Law
PM	particulate matter
PNNL	Pacific Northwest National Laboratory
POWER 2020	Power 2020 conference
PRA	probabilistic risk assessment
PWR	pressurized-water reactor
PYSL	post-yolk-sac-larvae
RCRA	Resource Conservation and Recovery Act of 1976, as amended
rem	roentgen equivalent(s) man
REMP	radiological environmental monitoring program
RG	Regulatory Guide
ROI	region(s) of influence
ROW	right-of-way
SAMA	severe accident mitigation alternatives
sec	second
SEIS	Supplemental Environmental Impact Statement
SER	safety evaluation report
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SLR	subsequent license renewal
SMR	small modular reactor
SO_2	sulfur dioxide
SOARCA	State-of-the-Art Reactor Consequences
SPDES	state pollution discharge elimination system
SSC	structure, system, and component
Sv	sievert(s)
SWPP	Stormwater Pollution Prevention Plan
UCB	upper confidence bound
UIDL	unidentified life stage
U.S.	United States
U.S.C.	*United States Code*
USACE	United States Army Corps of Engineers

USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USGCRP	U.S. Global Change Research Program
USGS	U.S. Geological Survey
VCEA	Virginia Clean Economy Act of 2020
VDEQ	Virginia Department of Environmental Quality
VDGIF	Virginia Department of Game and Inland Fisheries
VDH	Virginia Department of Health
VDWR	VA Department of Wildlife Resources
VEPCO	Virginia Electric Power Company
VOC	volatile organic compound
VPDES	Virginia Pollutant Discharge Elimination System
VSR	Virginia State Route
VWP	Virginia Water Protection
WHTF	waste heat treatment facility
WTG	wind turbine generator
YOY	young-of-year
yr	year
YSL	yolk-sac larvae

1 INTRODUCTION AND GENERAL DISCUSSION

The U.S. Nuclear Regulatory Commission's (NRC's) environmental protection regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51 (TN250), "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," implement the National Environmental Policy Act of 1969 (NEPA), as amended (42 U.S.C. 4321 et seq.; TN661). The regulations at 10 CFR Part 51 (TN250) require, in part, that the NRC prepare an environmental impact statement (EIS) before the issuance or renewal of a license to operate a nuclear power plant.

The Atomic Energy Act of 1954, as amended (AEA) (42 U.S.C. 2011 et seq.; TN663), specifies that licenses for commercial power reactors can be granted for up to 40 years. The initial 40--year licensing period was based on economic and antitrust considerations rather than on technical limitations of the nuclear facility. NRC regulations permit these licenses to be renewed beyond the initial 40-year term for an additional time period, limited to 20-year increments per renewal. Renewal is based on the results of (1) the NRC staff's environmental review and (2) the NRC staff's safety review (10 CFR 54.29, "Standards for Issuance of a renewed license;" TN4878). Neither the AEA nor the NRC's regulations restrict the number of times a license may be renewed. The decision to seek a renewed license rests entirely with nuclear power plant owners and typically is based on the power plant's economic viability and the investment necessary to continue to meet all safety and environmental requirements. The NRC makes the decision to grant or deny license renewal based on an evaluation of the environmental impacts of license renewal and whether the applicant has demonstrated reasonable assurance that it can meet the safety requirements in the agency's regulations during the period of extended operation.

Pursuant to 10 CFR Part 51 (TN250), the NRC conducted an environmental review of Virginia Electric and Power Company, doing business as Dominion Energy Virginia's (Dominion's), August 24, 2020, request for subsequent license renewal (SLR) (VEPCO 2020-TN8383), as supplemented on February 4, 2021, (VEPCO 2021-TN8178), February 10, 2021 (VEPCO 2021-TN8268), February 11, 2021 (VEPCO 2021-TN8179), March 17, 2021 (VEPCO 2021-TN8180), and September 28, 2022 (VEPCO 2022-TN8270). Dominion requested renewed facility operating licenses for North Anna Power Station, Units 1 and 2 (North Anna) for a period of 20 years beyond the dates when the initial renewed facility operating licenses would expire; that is, 20 years beyond the current license expiration dates of April 1, 2038, for North Anna Unit 1 and August 21, 2040, for North Anna Unit 2. Dominion also submitted its environmental report (ER) (VEPCO 2020-TN8099) with its August 2020 SLR application, which it supplemented by letter dated September 28, 2022 (ER Supplement 1) (VEPCO 2022-TN8270).

The NRC previously documented its environmental review as a draft supplement to NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, Revision 1, Final Report (LR GEIS; NRC 2013-TN2654). Specifically, in August 2021, the NRC issued a draft supplement to the LR GEIS, titled *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, Supplement 7, Second Renewal, Regarding Subsequent License Renewal for North Anna Power Station Units 1 and 2, Draft Report for Comment (NUREG-1437, Supplement 7, Second Renewal) (DSEIS) (NRC 2021-TN7294). The DSEIS evaluated the impacts of license renewal issues determined to be site-specific (Category 2) in the LR GEIS on a site-specific basis. For license renewal issues determined to be generic (Category 1) issues in the LR GEIS, the DSEIS adopted the LR GEIS's findings. The NRC received public comments on the DSEIS; these comments are addressed in Appendix A.2, "Comments Received on the North Anna Power Station, Units 1 and 2 DSEIS Environmental Review," in this EIS. On February 24, 2022, the NRC Commission issued three memoranda and orders that addressed SLR proceedings for five nuclear power plant SLR applications. One of those orders, Commission Legal Issuance CLI-22-03 (NRC 2022-TN8272), addressed the North Anna SLR application. In those orders, the Commission concluded that the LR GEIS, on which the NRC staff had relied, in part, to meet its obligations under 10 CFR Part 51 (TN250) and NEPA (TN661), for its environmental reviews of those SLR applications, did not consider SLR. Therefore, the Commission determined that the staff's SLR environmental reviews, including the environmental review for the North Anna SLR application, were inadequate.

In CLI-22-03, the Commission directed the NRC staff to update the LR GEIS so that it covers nuclear power plant operation during the SLR period of extended operations (PEO) (NRC 2022-TN8272). The Commission stated that the most efficient way to proceed would be for the NRC staff to review and update the LR GEIS and then take appropriate action with respect to pending SLR applications to ensure that the environmental impacts for the period of SLR are considered. However, the Commission afforded SLR applicants an opportunity to submit a revised ER providing additional information about environmental impacts during the SLR PEO, in which they evaluate, on a site-specific basis, the environmental impacts that were dispositioned in Table B-1 in Appendix B to Subpart A of 10 CFR Part 51 (TN250) and the LR GEIS as Category 1 issues (generic to all or a distinct subset of nuclear power plants). For SLR applicants that provide such information, the NRC staff was directed to address the environmental impacts of these issues in site-specific EISs.

Following the issuance of CLI-22-03 on September 28, 2022, Dominion submitted a supplement to its ER in which it presented a site-specific environmental review of the impacts of continued operations of North Anna during the SLR PEO (VEPCO 2022-TN8270). That analysis supplemented the ER included in Dominion's SLR application and addressed on a site-specific basis each environmental issue that previously had been dispositioned as a Category 1 issue in the 2013 LR GEIS and Dominion's ER.

This draft site-specific EIS considers the impacts of all subsequent license renewal issues applicable to North Anna SLR on a site-specific basis, including the site-specific issues considered in the August 2021 DSEIS as well as the issues that had been treated as generic Category 1 issues in the August 2021 DSEIS. This draft site-specific EIS considers information in Dominion's SLR application, as supplemented; Dominion's September 28, 2022, submittal; the staff's consultation with Federal, State, Tribal, and local government agencies; and other new information, as appropriate. In addition, Appendix A, Section A.2 of this EIS presents the comments that the NRC staff received on the DSEIS and the staff's responses thereto. The NRC staff considered those comments, as appropriate, in the discussions and analyses contained in this draft site-specific EIS. Thus, this draft site-specific EIS supersedes the 2021 DSEIS.

1.1 Proposed Federal Action

Dominion initiated the proposed Federal action (renewal of operating licenses) by applying for SLR of North Anna to the NRC. The initial renewed facility operating licenses are set to expire at midnight on April 1, 2038, for Unit 1 (NPF-4) and August 21, 2040, for Unit 2 (NPF-7). The NRC's Federal action is to decide whether to renew the current North Anna operating licenses for an additional 20 years of reactor operation. If the NRC issues the subsequent renewed licenses, North Anna would be authorized to operate until April 1, 2058 (Unit 1), and August 21, 2060 (Unit 2).

1.2 Purpose and Need for the Proposed Federal Action

The purpose and need for the proposed action (subsequent renewal of the North Anna operating licenses) is to provide an option that allows for power generation capability beyond the term of the current operating licenses to meet future system generating needs, as such needs may be determined by energy-planning decision-makers, such as State regulators, utility owners, and Federal agencies other than the NRC. This definition of purpose and need reflects the NRC's recognition that, unless there are findings in the NRC's safety review required by the AEA or in the NEPA environmental analysis that would lead the NRC to reject the SLR application, the NRC does not have a role in the energy-planning decisions of State regulators and utility officials as to whether a nuclear power plant should continue to operate.

1.3 Major Environmental Review Milestones

Dominion submitted an ER as Appendix E to its SLR application on August 24, 2020 (VEPCO 2020-TN8099). The NRC published a notice of the receipt of the application in the *Federal Register* (FR) on September 21, 2020 (Volume 85 of the FR, p. 59334 [85 FR 59334-TN8293]). After reviewing the SLR application and ER, as supplemented, the NRC staff accepted the application for a detailed technical review on October 9, 2020. The staff published a *Federal Register* notice of acceptability for docketing and opportunity for hearing on October 15, 2020 (85 FR 65438-TN8292). On October 23, 2020, the NRC published a notice in the *Federal Register* (85 FR 67572-TN8294) informing the public of the staff's intent to conduct an environmental scoping process, which began a 30-day scoping comment period. The NRC staff held a virtual public scoping meeting on November 4, 2020. In June 2021, the NRC issued a scoping summary report for North Anna SLR (NRC 2021-TN8295), which included the comments received during the 2020 scoping process (see Appendix A.1 of this draft site-specific EIS).

The NRC staff conducted a remote environmental audit of North Anna during the week of December 1, 2020, and a severe accident mitigation alternatives (SAMAs) remote audit on December 9, 2020, to independently verify information in Dominion's ER. During these audits, the NRC staff held meetings with plant personnel and reviewed site-specific documentation and photos. The staff summarized these audits in letters dated December 17, 2020, and January 22, 2021 (NRC 2020-TN8100 and NRC 2021-TN8177).

Upon completion of the 2020 scoping period, site audits, review of Dominion's ER and related documents, and its own environmental analysis, the NRC staff compiled its findings into the DSEIS (NRC 2021-TN8181) and issued it for public comment for a period of 45 days.

On September 28, 2022, Dominion submitted a supplement to its ER, in which it presented a site-specific environmental review of the impacts of continued operations of North Anna during the SLR PEO for those environmental issues for which Dominion had previously relied on the LR GEIS's generic findings in its ER (VEPCO 2022-TN8270. On November 15, 2022, consistent with the Commission's Order concluding that the LR GEIS did not address SLR (CLI-22-03) (NRC 2022-TN8272), the NRC staff issued a "Notice of Intent To Conduct Scoping Process and Prepare Supplement To Draft Environmental Impact Statement Virginia Electric and Power Company North Anna Power, Units 1 and 2" (87 FR 68522, TN8588). The notice announced the NRC staff's intention to conduct a limited scoping process to gather information necessary to prepare a supplement to the 2021 DSEIS and to seek comment on the proper scope of this draft site-specific EIS supplement for North Anna subsequent license renewal. This scoping process was limited to: (1) applicable ''Category 1'' (generic) issues listed in the 2021 DSEIS at

Table 3-1, for the purpose of making site-specific findings (e.g., SMALL, MODERATE, LARGE) on those issues and (2) any significant new information on ‘‘Category 2’’ (site-specific) issues listed in the 2021 DSEIS at Table 3-2 that may have arisen following the issuance of the 2021 DSEIS. In December 2023, the NRC issued a second scoping summary report for North Anna SLR (NRC 2023-TN9555), which included comments received during the 2022 limited scoping period (see Appendix A).

Figure 1-1 shows the major milestones of the environmental review portion of the NRC staff’s review process for the North Anna SLR application. This draft site-specific EIS is being issued for public comment. The EIS public comment process provides an opportunity for the NRC staff’s consideration and incorporation of public comments on this draft site-specific EIS.

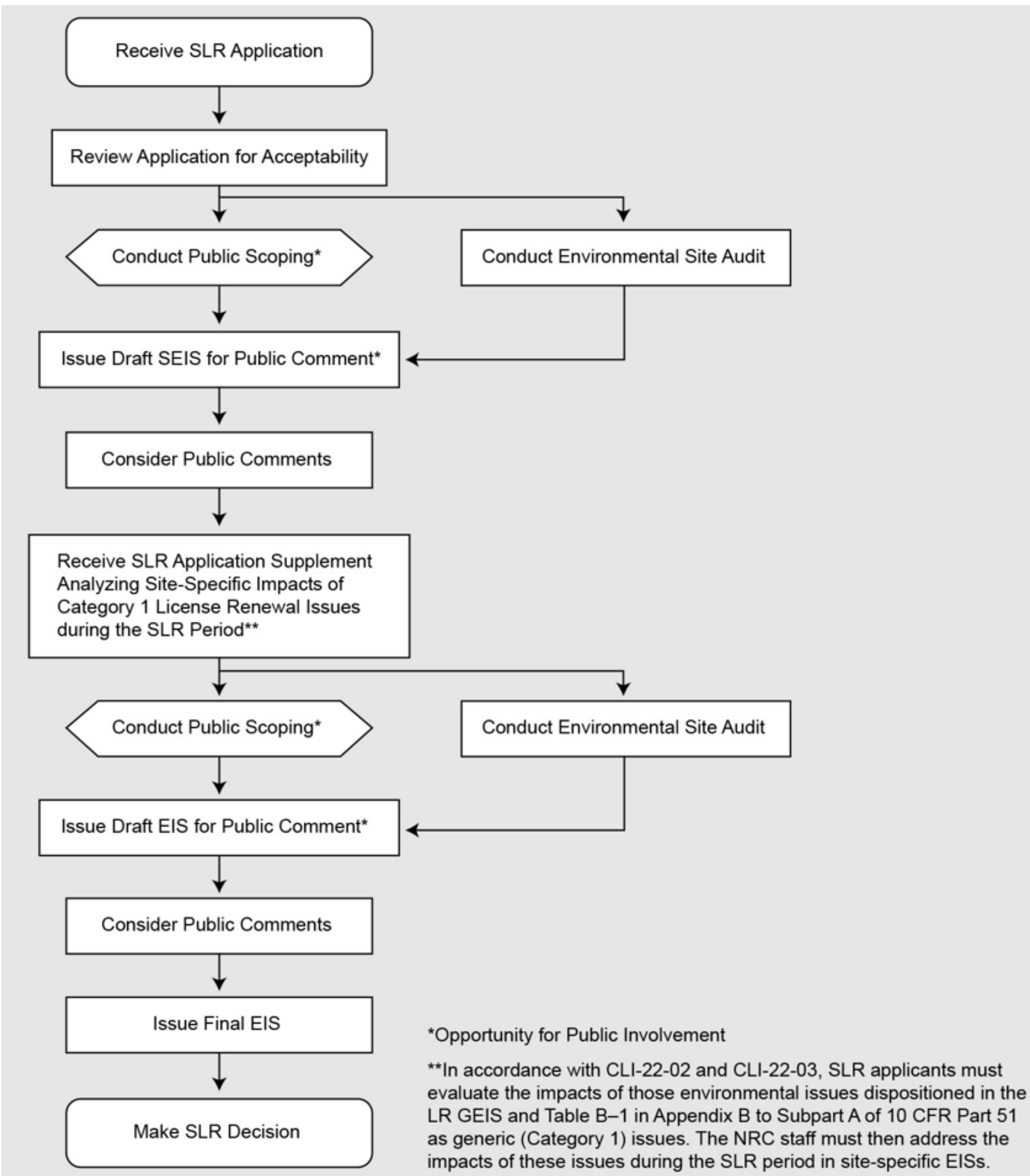


Figure 1-1 Environmental Review Process

The NRC has established a process that the NRC staff and license renewal applicants can complete in a reasonable period of time and that includes clear requirements to assure safe nuclear power plant operation for up to an additional 20 years of nuclear power plant life, pursuant to 10 CFR Part 54 (TN4878), “Requirements for Renewal of Operating Licenses for Nuclear Power Plants.” This process consists of separate safety and environmental reviews, which the NRC staff conducts simultaneously and documents in two reports; the safety evaluation report (SER) documents the safety review, and the EIS documents the environmental review. Both reports factor into the NRC’s decision to issue or deny a renewed license.

1.4 Environmental Issues Evaluated in This EIS

In 1996, as supplemented in 1999, and revised in 2013, the NRC generically assessed many of the environmental impacts of nuclear power plant license renewal in NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants* (LR GEIS) (NRC 1996-TN288, NRC 1999-TN289, NRC 2013-TN2654). The NRC undertook this generic review to establish a systematic approach to evaluating the environmental consequences of renewing individual nuclear power plant operating licenses for up to a 20-year period.

The 2013 revision of the LR GEIS (NRC 2013-TN2654) established 78 environmental impact issues for license renewal. For each of these issues, the NRC determines whether the analysis of the environmental issue in the LR GEIS could be applied to all (or a distinct subset of) nuclear power plants seeking license renewal and whether additional mitigation measures would be warranted. Based on this determination, the NRC staff then designates each environmental issue as Category 1 (generic to all or a distinct subset of nuclear power plants) or Category 2 (site-specific to certain nuclear power plants only). For initial license renewal applications, a site-specific supplement to the LR GEIS is developed that considers the applicable Category 1 and Category 2 issues for the site under review. For generic issues (Category 1), the staff can adopt the LR GEIS’s analysis and conclusions unless new and significant information that invalidates the conclusion summary in the GEIS is identified during a site-specific review. For Category 2 issues, the staff must perform a site-specific environmental review for each license renewal application. The NRC codified the conclusions in the LR GEIS in Appendix B to Subpart A of 10 CFR Part 51 (TN250), “Environmental Effect of Renewing the Operating License of a Nuclear Power Plant.”

For subsequent license renewal, the Commission directed the NRC staff in CLI-22-03 to update the LR GEIS to address SLR, and it afforded SLR applicants an opportunity to submit a site-specific ER and to request a site-specific environmental evaluation by the NRC staff. The NRC staff prepared this draft site-specific EIS in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN8272) and the requirements in 10 CFR 51.70 (TN250), “Draft Environmental Impact Statements—General Requirements.” Whereas the 2021 DSEIS considered some issues as generic in accordance with the 2013 LR GEIS, in this draft site-specific EIS, the impacts of all license renewal issues applicable to North Anna SLR are considered on a site-specific basis. This draft site-specific EIS considers information in Dominion’s SLR application, as supplemented including Dominion’s September 28, 2022 (VEPCO 2022-TN8270), supplement; the staff’s consultation with Federal, State, Tribal, and local government agencies; and other new information, as appropriate. In addition, Appendix A, Section A.2 of this draft site-specific EIS presents the comments that the NRC staff received on the DSEIS and the staff’s responses thereto. The NRC staff considered those comments, as appropriate, in the discussions and analyses contained in this draft site-specific EIS. This draft site-specific EIS, which is being issued for public comment, supersedes the 2021 DSEIS.

In this draft site-specific EIS, the NRC staff evaluates 65 environmental issues applicable to North Anna SLR. Table B–1 in Appendix B to Subpart A of 10 CFR Part 51 (TN250) and the LR GEIS dispositioned 51 of these issues as “generic” or “Category 1” issues. In the DSEIS, the NRC staff relied on the analysis and conclusions in the LR GEIS and Table B-1 for each of these 51 issues and concluded that there would be no impacts related to these issues beyond those already discussed in the LR GEIS. For each of these issues, the staff’s DSEIS adopted the LR GEIS’s conclusions of “SMALL.” However, as explained above under “Background,” in its 2022 Orders, the Commission determined that the staff cannot rely on the LR GEIS for its SLR reviews. Therefore, in this draft site-specific EIS, the NRC staff addresses each of those 51 “generic” environmental issues on a site-specific basis.

In addition, in the 2021 DSEIS, the NRC staff evaluated 12 environmental issues for North Anna SLR on a site-specific basis. Table B–1 in Appendix B to Subpart A of 10 CFR Part 51 (TN250) and the LR GEIS dispositioned these issues as “site-specific” or “Category 2” issues. In the DSEIS, the NRC staff performed site-specific evaluations and made site-specific findings of SMALL, MODERATE, or LARGE for each of these issues. This draft site-specific EIS supersedes the 2021 DSEIS (87 FR 68522-TN8588) and includes the NRC staff’s analysis from the 2021 DSEIS, with updates and revisions, as appropriate.

The NRC staff has also considered whether any additional environmental issues exist beyond the 65 issues identified in the LR GEIS that would apply to North Anna during the SLR PEO. The NRC staff identified no such issues during its review of Dominion’s ER, as supplemented, or as a result of the environmental scoping process, the environmental site audit, or consultations with Federal, State, and local agencies and American Indian Tribes. Generally, SLR would allow current operating conditions and environmental stressors to continue rather than introduce wholly new impacts that did not exist during the original license period or the initial license renewal period. Therefore, in this draft site-specific EIS, the NRC staff conducted a site-specific analysis for each of the 65 issues applicable to North Anna during the SLR PEO.

The NRC characterizes potential impacts according to three levels of significance for potential impacts—SMALL, MODERATE, and LARGE:

SMALL indicates that the environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE indicates that the environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE indicates that the environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

1.5 Structure of This EIS

This draft site-specific EIS presents the analysis of the environmental effects of the continued operation of North Anna through the SLR term, reasonable alternatives to SLR, and mitigation measures for minimizing adverse environmental impacts. Chapter 3, “Affected Environment, Environmental Consequences, and Mitigating Actions,” contains an analysis and comparison of the potential environmental impacts from SLR and alternatives to SLR. Chapter 4, “Conclusion,” presents the NRC staff’s preliminary recommendation on whether the environmental impacts of SLR are so great that preserving the option of SLR would be unreasonable. The NRC staff will consider the public comments that it receives on this draft site-specific EIS and will then issue its final site-specific EIS. The NRC staff will make its final recommendation on North Anna's SLR application in a Record of Decision to be issued following issuance of the final site-specific EIS.

In preparing this draft site-specific EIS, the NRC staff carried out the following activities:

- reviewed Dominion's ER, as supplemented
- consulted with Federal, State, and local agencies and American Indian Tribes
- conducted independent site-specific evaluations of each environmental issue relevant to North Anna SLR
- performed environmental and SAMA site audits
- considered public comments received on the 2021 DSEIS
- considered public comments received during the two scoping comment periods

New information can come from many sources, including the applicant, the NRC, other agencies, or public comments. If new information reveals a new issue that the NRC was not aware of, the staff will first analyze the issue to determine whether it is within the scope of the license renewal environmental review. If the staff determines that the new issue bears on the proposed action or its impacts, the staff will then determine the significance of the issue for the plant and will address the issue in the EIS, as appropriate.

1.6 Decision To Be Supported by the EIS

This draft site-specific EIS provides information and analyses to support the NRC's decision on whether to renew the North Anna operating licenses for an additional 20 years. The regulation at 10 CFR 51.103(a)(5) (TN250) specifies the NRC's decision standard as follows:

> In making a final decision on a license renewal action pursuant to [10 CFR] Part 54 of this chapter, the Commission shall determine whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decision-makers would be unreasonable.

There are many factors that the NRC takes into consideration when deciding whether to renew the operating license of a nuclear power plant. The analysis of environmental impacts in the EIS will provide the NRC's decision-makers (the Commission) with important environmental information for consideration in deciding whether to renew the North Anna operating licenses.

1.7 Cooperating Agencies

During the scoping process, the NRC staff did not identify any Federal, State, or local agencies as cooperating agencies for this EIS.

1.8 Consultations

Certain Federal environmental statutes require Federal agencies to consult with other agencies, Tribes, and organizations before taking an action that may affect protected environmental resources, such as endangered species, habitat of managed fisheries, and historical and cultural resources. These include the Endangered Species Act (ESA) of 1973, as amended

(16 U.S.C. 1531 et seq. – TN1010); the Magnuson–Stevens Fisheries Conservation and Management Act (MSA) of 1996, as amended (16 U.S.C. 1801 et seq. – TN7841); and the National Historic Preservation Act (NHPA) of 1966, as amended (54 U.S.C. 300101 et seq.; TN4157), among others. See Appendix C for a list of the agencies and groups with which the NRC staff consulted.

1.9 Correspondence

During the review, the NRC staff contacted Federal, State, regional, local, and Tribal agencies listed in Appendix C. Appendix C chronologically lists all correspondence the NRC staff sent and received associated with the ESA, the MSA, and the NHPA. Appendix D chronologically lists all other correspondence.

1.10 Status of Compliance

Dominion is responsible for complying with all NRC regulations and other applicable Federal, State, and local requirements. Appendix F, "Laws, Regulations, and Other Requirements," of the LR GEIS, Revision 1, describes some of the major applicable Federal statutes. Numerous permits and licenses are issued by Federal, State, and local authorities for activities at North Anna. Appendix B of this draft site-specific EIS contains further information from the North Anna application about Dominion's status of compliance with applicable requirements.

1.11 Related State and Federal Activities

The staff reviewed the possibility that activities (projects) of other Federal agencies might impact the renewal of the operating licenses for North Anna. Any such activities could result in cumulative environmental impacts and the possible need for the Federal agency to become a cooperating agency for preparing this EIS. The NRC staff has determined that there are no Federal projects that would make it necessary for another Federal agency to become a cooperating agency in the preparation of this EIS (10 CFR 51.10(b)(2); TN250). Table E-1 in Appendix E includes the Federal facilities in the vicinity of North Anna. In addition, Table E-1 identifies the activities (projects) including State activities that were considered during the NRC staff's cumulative environmental impacts review.

Section 102(2)(C) of NEPA (TN661) requires the NRC to consult with and obtain comments from any Federal agency or designated authority that has jurisdiction by law or special expertise with respect to any environmental impact involved in the subject matter of the EIS. For example, during the preparation of this EIS, the NRC consulted with the Commonwealth of Virginia's State Historic Preservation Officer (SHPO), among others. Appendix C provides a complete list of consultation correspondence.

The NRC staff reviewed the North Anna status of compliance in Chapter 3 and Appendix B and notes that some State or Federal permitting and certification activities could affect operation under a renewed NRC license. For example, a Clean Water Act (CWA) Section 401 consistency certification and a Coastal Zone Management Act (CZMA) consistency determination will be needed for North Anna to operate during the SLR period of extended operation, as discussed in Sections 3.2.1 and 3.4.1 of this draft site-specific EIS. In appropriate circumstances (not present here), construction of water intake structures, access roads, or rail spurs may be required for the NRC license renewal action to be implemented. In such instances, some nuclear power plant construction activities may require a license amendment and an environmental review by the NRC. However, no such activities have been identified for North Anna SLR.

2 ALTERNATIVES INCLUDING THE PROPOSED ACTION

The NRC's decision-making authority in license renewal is limited to deciding whether to renew a nuclear power plant's operating license. The agency's implementation of NEPA (42 U.S.C. 4321 et seq.; TN661), requires consideration of the environmental impacts of license renewal and reasonable alternatives to renewing a nuclear power plant's operating license. Although the ultimate decision on which alternative (or the proposed action) to carry out falls to the nuclear plant owner, State, or other non-NRC Federal officials, comparing the impacts of renewing the operating license to the environmental impacts of reasonable alternatives allows the NRC to determine whether the environmental impacts of license renewal are so great that it would be unreasonable for the agency to preserve the option of license renewal for energy-planning decision-makers.

Energy planning decision-makers and utility owners ultimately decide whether the nuclear power plant will continue to operate, and economic and environmental considerations play important roles in this decision. In general, the NRC's responsibility is to ensure the safe operation of nuclear power facilities, not to formulate energy policy or promote nuclear power, or encourage or discourage the development of alternative power generation. The NRC does not engage in energy-planning decisions, and it makes no judgment as to which replacement energy alternatives would be the most-likely alternative selected in any given case.

This chapter describes (1) the North Anna nuclear power plant site and its operation, (2) the proposed action (renewal of the North Anna operating licenses), (3) reasonable alternatives to the proposed action (including the no-action alternative), and (4) alternatives eliminated from detailed study.

2.1 Description of Nuclear Power Plant Facility and Operation

The physical presence of the North Anna buildings and facilities, as well as the nuclear power plant's operations, are integral to creating the environment that currently exists at and around the site. This section describes certain nuclear power plant operating systems and certain nuclear power plant infrastructure, operations, and maintenance.

2.1.1 External Appearance and Setting

North Anna is located on the border of Louisa and Spotsylvania counties in northeastern Virginia, on a peninsula along the southern shore of Lake Anna. The town of Mineral is located about 7 miles (mi) (11 kilometers [km]) west–southwest, and the town of Louisa (Louisa County seat) is located about 12 mi (19 km) west of the North Anna site. The city of Richmond (the State capital) is the largest population center in the region and is about 40 mi (64 km) southeast of the site (Figure 2-1).

The principal North Anna nuclear power plant structures are the reactor containments for Units 1 and 2, the auxiliary building, the fuel building, the turbine building, and the main 500 kilovolt switchyard. The physical setting is predominantly rural and rural residential, characterized by farmland and wooded tracts, as well as by the open water of Lake Anna (VEPCO 2020-TN8099).

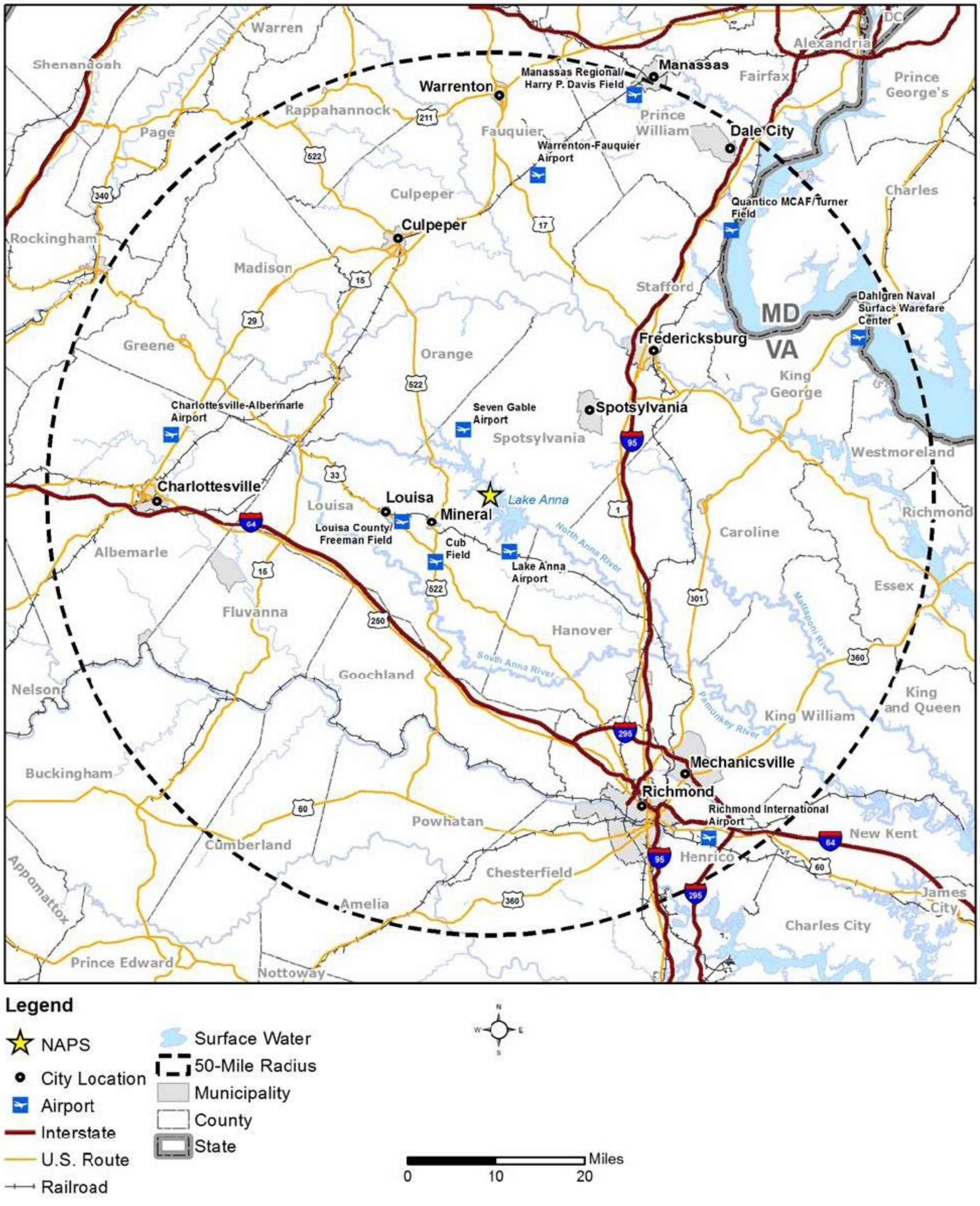


Figure 2-1 North Anna Power Station 50-mi (80-km) Radius Map. Adapted from: VEPCO 2020-TN8099

2.1.2 Nuclear Reactor Systems

North Anna has Westinghouse pressurized-water reactors (PWRs) with dry containments (steel lined and reinforced concrete). The NRC issued the original North Anna operating licenses on April 1, 1978, and August 21, 1980, respectively, and the first renewed licenses on March 20, 2003 (NRC 2020-TN7241). The nuclear reactors produce a nominal core power rating of 2,940 megawatts thermal (MWt) (VEPCO 2020-TN8099).

North Anna fuel is low-enriched uranium dioxide (limited to 5 percent by weight uranium-235) ceramic pellets. The pellets are sealed in tubes made of ZIRLO or optimized ZIRLO. North Anna refueling occurs about every 18 months (VEPCO 2020-TN8099).

2.1.3 Cooling and Auxiliary Water Systems

Section 2.1.3 of NUREG-1437, Supplement 7, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding North Anna Power Station, Units 1 and 2*, describes the operation of the nuclear power plant's cooling and auxiliary water systems including the withdrawal of water from Lake Anna and the return flow of heated water to the lake (NRC 2002-TN8296: Section 2.1.3, p. 2-7). Section E2.2.3 of Dominion's ER, submitted as part of its SLR application, provides an expanded description of North Anna's cooling and auxiliary water systems, including the circulating water system, service water system, ultimate heat sink, component cooling water system, fire protection and domestic water supply systems, discharge canal, and waste heat treatment facility (WHTF) (VEPCO 2020-TN8099: Section E2.2.3, p. E-2-4 to E-2-11). The NRC staff incorporates this information here by reference and summarizes key information in the following subsections.

Pressurized-water reactors, such as those at North Anna, heat water to a high temperature under pressure inside the reactor. This type of steam and power conversion system uses three heat transfer (exchange) loops. North Anna uses a once-through cooling loop (circulating-water system) to dissipate heat from the turbine condensers. Figure 2-2 provides a basic schematic diagram of this system.

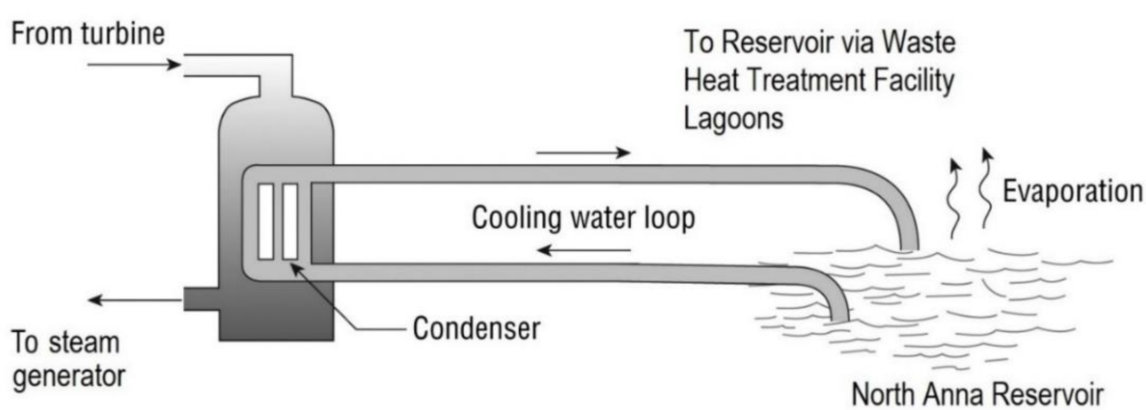


Figure 2-2 Schematic Diagram of Once-Through Cooling Water System with Reservoir Water in a Nuclear Power Plant. Source: NRC 2013-TN2654

2.1.3.1 Cooling Water Intake and Discharge

A nuclear power plant's circulating-water system is the principal interface with the hydrologic environment. North Anna withdraws water from North Anna Reservoir through two screen wells (one for each nuclear unit) housed in the intake structure. Each screen-well contains four intake bays, each of which is equipped with a trash rack and movable rake, a traveling screen, and a circulating-water pump. Large debris in the intake water collects on the trash racks, where the rake removes the debris and discharges it into a collection basket. The traveling screens remove smaller debris prior to entering the pumps. The screens have 1/8-in. (0.32 cm) by 1/2-in. (1.27 cm) mesh openings and operate based on a differential pressure trigger. Debris and fish collected from the traveling screens wash into wire baskets for disposal as solid waste.

Each of North Anna's eight circulating-water pumps are rated at 238,200 gallons per minute (gpm) (901.6 cubic meters per minute [m^3/min]). Lake Anna is also a source of makeup water to the service water system. This system supports the component cooling system and dissipates heat using a spray array in the service water reservoir. The service water reservoir and Lake Anna comprise the nuclear power plant's ultimate heat sink. Two service water pumps are also located in the intake structure. Each pump is contained in its own screen-well, which is equipped with a trash rack and traveling screen. Each service water pump is rated at 11,500 gpm (43.5 m^3/min). In total, North Anna's maximum surface water withdrawal rate is 1,928,600 gpm (7,290 m^3/min). This rate is equivalent to approximately 2,777 million gallons per day (mgd) (10,512 million liters per day [mLd]). Section 3.4.1 of this EIS summarizes North Anna's surface water withdrawals.

Water entering the circulating-water intake structure bays is pumped through the condensers. The heated circulating water, along with comingled effluents, exits the discharge structure at the top (north end) of the discharge canal (Figure 2-3). The nominal (design) temperature rise in the circulating water passing through the condenser is 14.5 °F (8.1 °C). From the discharge canal, the combined effluent enters the first of three, interconnected cooling lagoons that constitute the WHTF. The residence time of the cooling water effluent in the WHTF is about 14 days, which allows for substantial heat loss. The effluent mixes with the ambient water as it travels through each of the three lagoons before exiting the WHTF and entering Lake Anna Reservoir at the skimmer wall structure outlet. The structure discharges the effluent as a submerged jet into the lake and promotes thorough mixing with the lake water. This point is also designated as Outfall 001 under Dominion's Virginia Pollutant Discharge Elimination System (VPDES) permit (see Figure 3-4).

2.1.3.2 Well Water Supply System

Seven groundwater wells supply North Anna's domestic and miscellaneous water needs across the nuclear power plant site. Four wells (wells 6, 7, 8, and the North Anna Nuclear Information Center well) comprise the nuclear power plant's domestic supply system, with wells 6, 7, and 8 comprising a single system. The well system supplies water for all domestic applications in the nuclear power plant, from sanitation to drinking fountains and eyewash stations. The well water system is not interconnected to any other nuclear power plant process water system, and all four wells are permitted by the Virginia Department of Health. In addition, three other wells (the metrology well, security training building well, and SS-1 well) provide small volumes of water to support uses at more remote nuclear power plant site locations. These three wells do not require permits. Table E3.6-3 of Dominion's ER provides construction details for all seven wells (VEPCO 2020-TN8099). Section 3.4.2 of this EIS discusses North Anna's groundwater withdrawals.

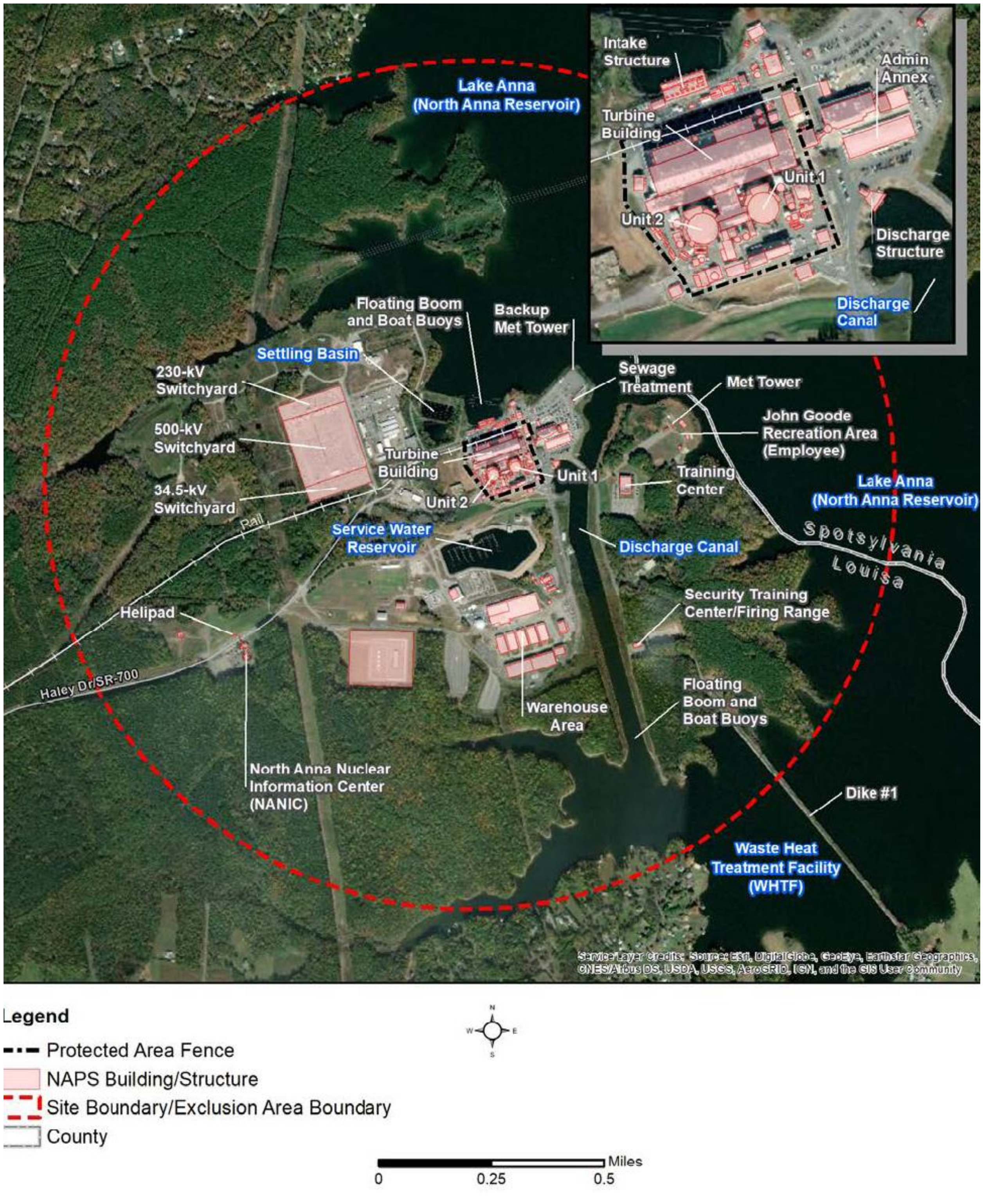


Figure 2-3 North Anna Water Intake and Discharge Locations and Hydrologic Features. Source: VEPCO 2020-TN8099

2.1.4 Radioactive Waste Management Systems

Section 2.1.4 of NUREG-1437, Supplement 7 describes North Anna's radioactive waste treatment systems (NRC 2002-TN8296: Section 2.1.4, p. 2-8–2-12). Section E2.2.6 of Dominion's ER provides an expanded description of North Anna's radioactive waste treatment systems (VEPCO 2020-TN8099: Section E2.2.6, p. E-2-16 to E-2-26). This information is incorporated here by reference, with key information summarized below and in the following subsections.

The NRC licenses nuclear power plants with the expectation that they will release some radioactive material to both the air and water during normal operations. However, NRC regulations require that gaseous and liquid radioactive releases from nuclear power plants meet radiation dose-based limits specified in 10 CFR Part 20 (TN283), "Standards for Protection Against Radiation," and the as-low-as-reasonably-achievable (ALARA) criteria in 10 CFR Part 50 (TN249), Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low as is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents." In other words, the NRC places regulatory limits on the radiation dose that members of the public can receive from the radioactive effluents of a nuclear power plant. For this reason, all nuclear power plants use radioactive waste management systems to control and monitor radioactive wastes.

North Anna uses liquid, gaseous, and solid waste management systems to collect and process radioactive materials and waste produced as a byproduct of nuclear power plant operations. The waste disposal systems can handle the waste produced by simultaneous operation of the two nuclear units. These waste management systems ensure that the dose to members of the public from radioactive effluents is reduced to ALARA levels in accordance with NRC regulations.

Dominion maintains a radiological environmental monitoring program (REMP) to assess the radiological impact, if any, to the public and the environment from radioactive effluents released during operations at North Anna. The REMP is discussed in Section 2.1.4.5.

Dominion has an Offsite Dose Calculation Manual (ODCM) that contains the methods and parameters for calculating offsite doses resulting from liquid and gaseous radioactive effluents. These methods ensure that radioactive material discharges from North Anna meet NRC and U.S. Environmental Protection Agency (EPA) regulatory dose standards. The ODCM also contains the requirements for the REMP.

2.1.4.1 Radioactive Liquid Waste Management

Dominion uses waste management systems to collect, analyze, and process radioactive liquids produced at North Anna. These systems reduce radioactive liquids before they are released to the environment. The North Anna liquid waste disposal system meets the design objectives of 10 CFR Part 50, Appendix I (TN249), and controls the processing, disposal, and release of radioactive liquid wastes.

The liquid waste disposal system is common to both reactors and accommodates radioactive waste produced during simultaneous operation. The system was designed to receive, process, and discharge potentially radioactive liquid waste. In summary, potentially radioactive liquid wastes originate from the chemical and volume control system, the boron recovery system, the steam generator blowdown system, the vent and drain system sumps, laboratory drains, personnel decontamination area drains, the decontamination system, the sampling system, laundry drains, and spent resin flush water. The system design considers potential personnel exposure and ensures that radioactive releases to the environment are as low as reasonably achievable. During normal nuclear power plant operation, the total activity from radionuclides leaving the discharge canal does not exceed the limits of applicable regulations. The sources of radioactivity are from the core, fuel rod gap, coolant, and volume control tank for a core with 15 × 15 fuel assemblies.

Various building sump effluents from the vent and drain system are directed by valve lineups to either the high-level or low-level waste drain tanks, depending on the influent activity level. The contaminated drain tanks receive laundry waste and cold laboratory drainage, personnel decontamination area (PDA) shower and PDA sink drainage. The high-level waste drain tanks receive discharges directly from the hot laboratory drainage and spent resin flush water. They also receive high-level liquid waste from the vent and drain, liquid waste disposal, chemical and volume control, and boron recovery systems. The contents of the high-level waste drain tanks are processed by the ion exchanger filtration system and may be transferred to the low-level waste drain tanks via administrative controls if further treatment is not required. The decontamination system fluid waste treating tank in the decontamination building can be used for additional storage of high-level wastes if necessary. If the activity level of liquids in the low-level drain tanks and the contaminated drain tanks are such that the liquids require further processing, these liquids may also be included in the high-level waste drain tanks. There is a hold-up period in the high-level drain tanks for sampling the liquid before it is processed.

The low-level waste drain tanks accumulate waste from the ion exchange filter system, vents and drains, boron recovery systems, the fluid waste treating tank, and boron recovery test tanks. The liquids in the low-level waste drain tanks are pumped to the waste header, through the clarifier, and are then discharged to the circulating-water system or are processed through the liquid waste demineralizer, if needed, prior to discharge. Liquids from the contaminated drain tank, the steam generator blowdown tank, and blowdown from the service water reservoir also could go to the demineralizers in the waste disposal building. North Anna monitors these liquids prior to release to ensure that they will not exceed the limits of 10 CFR Part 20 (TN283). North Anna performs offsite dose calculations based on effluent samples obtained at this release point to ensure the limits of 10 CFR Part 50, Appendix I (TN249) are not exceeded. All liquid waste is discharged to the circulating-water system and is monitored to ensure radiological control.

North Anna performs periodic sampling of the liquid waste effluent. Prior to discharge, automatic isolation of liquid wastes occurs downstream of the clarifier demineralizer filter when a signal is received from the radiation monitor. The isolation valve can also be operated remotely from the main control room or automatically by a signal from the clarifier surge tank level switches. High activity detected by the radiation monitor overrides the valve control and stops all discharge flow. The discharge flow from the liquid waste disposal system is combined and mixed with the water in the circulating-water discharge tunnel so that the concentration of activity of the combined effluent is maintained ALARA and within NRC limits.

The ODCM prescribes the alarm/trip setpoints for the liquid effluent radiation monitors. Dominion's use of these radiological waste systems and the procedural requirements in the ODCM assures the agency that the dose from radiological liquid effluents at North Anna complies with NRC and EPA regulatory dose standards. Dominion calculates dose estimates for members of the public using radiological liquid effluent release data.

Dominion's annual radioactive effluent release reports contain a detailed presentation of liquid effluents released from North Anna and the resultant calculated doses. These reports are publicly available on the NRC's web page.

The NRC staff reviewed 5 years of radioactive effluent release data, from 2015 through 2019 in the DSEIS, and a second 5-year set of data in this EIS from 2017 through 2021 (Virginia Electric and Power Company (VEPCO), 2018-TN8391, 2019-TN8392, 2020-TN8393, 2021-TN8394, 2022-TN8476). A 5-year period provides a dataset that covers a broad range of activities that occur at a nuclear power plant—such as refueling outages, routine operation, and maintenance—that can affect the generation of radioactive effluents into the environment. The NRC staff compared the data against NRC dose limits and looked for indications of adverse trends (i.e., increasing dose levels or increasing radioactivity levels).

As discussed below, effluent release data for each of the two 5-year periods analyzed by the NRC staff were found to be well below regulatory standards. For example, the calculated doses from radioactive liquid effluents released from North Anna during 2021 (VEPCO 2022-TN8476) are summarized below:

<u>North Anna Unit 1 in 2021</u>

- The total-body dose to an offsite member of the public from North Anna Unit 1 radioactive effluents was 1.78×10^{-1} millirem (mrem) (1.78×10^{-3} millisievert [mSv]), which is well below the 3 mrem (0.03 mSv) dose criterion in Appendix I to 10 CFR Part 50 (TN249).
- The maximum organ dose (gastrointestinal tract) to an offsite member of the public from North Anna Unit 1 radioactive effluents was 1.79×10^{-1} mrem (1.79×10^{-3} mSv), which is well below the 10 mrem (0.1 mSv) dose criterion in Appendix I to 10 CFR Part 50 (TN249).

<u>North Anna Unit 2 in 2021</u>

- The total-body dose to an offsite member of the public from North Anna Unit 2 radioactive effluents was 1.78×10^{-1} mrem (1.78×10^{-3} mSv), which is well below the 3 mrem (0.03 mSv) dose criterion in Appendix I to 10 CFR Part 50 (TN249).
- The maximum organ dose (gastrointestinal tract) to an offsite member of the public from North Anna Unit 2 radioactive effluents was 1.79×10^{-1} mrem (1.79×10^{-3} mSv), well below the 10 mrem (0.1 mSv) dose criterion in Appendix I to 10 CFR Part 50 (TN249).

In the values cited above, the NRC staff divided Dominion's reported total-body and maximum organ liquid effluent doses for the entire facility evenly between North Anna Units 1 and 2. This was done to attribute the approximate dose contribution to each of the licensed nuclear units. The NRC staff's review of Dominion's radioactive liquid effluent control program shows that the applicant maintained radiation doses to members of the public that were within NRC and the EPA's radiation protection standards as contained in Appendix I to 10 CFR Part 50 (TN249), 10 CFR Part 20 (TN283), and Title 40, "Protection of Environment," of 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations" (TN739). The NRC staff observed no adverse trends in the dose levels.

During the SLR term, Dominion will continue to perform routine nuclear power plant refueling and maintenance activities. Based on Dominion's past performance in operating a radioactive waste system at North Anna that maintains ALARA doses from radioactive liquid effluents, the NRC staff expects Dominion will maintain similar performance during the SLR term.

2.1.4.2 Radioactive Gaseous Waste Management

Dominion calculates dose estimates for members of the public based on radioactive gaseous effluent release data and atmospheric transport models. Dominion's annual radioactive effluent release reports present in detail the radiological gaseous effluents released from North Anna and the resultant calculated doses. As described above in Section 2.1.4.1, the NRC staff reviewed 5 years of radioactive effluent release data from the 2017 through 2021 reports (VEPCO 2018-TN8391, VEPCO 2019-TN8392, VEPCO 2020-TN8393, VEPCO 2021-TN8394, VEPCO 2022-TN8476). The NRC staff compared the data against NRC dose limits and looked for indications of adverse trends (i.e., increasing dose levels) over the period.

As discussed below, North Anna's radioactive gaseous effluent doses to members of the public were found to be well below appliable standards. For example, the calculated doses from radioactive gaseous effluents released from North Anna during 2021 (VEPCO 2022-TN8476) are summarized below:

<u>North Anna Unit 1 in 2021</u>

- The air dose due to noble gases with resulting gamma radiation in gaseous effluents was 8.75×10^{-6} millirad (mrad) (8.75×10^{-8} milligray), which is well below the 10 mrad (0.1 milligray) dose criterion in Appendix I to 10 CFR Part 50 (TN249).
- The air dose from beta radiation in gaseous effluents from North Anna Unit 1 was 7.31×10^{-6} mrad (7.31×10^{-8} milligray) dose, which is well below the 20 mrad (0.2 milligray) dose criterion in Appendix I to 10 CFR Part 50 (TN249).
- The critical organ dose to an offsite member of the public from radiation in gaseous effluents as a result of iodine-131, iodine-133, hydrogen-3, and particulates with greater than 8 day half-lives was 1.40 mrem (1.40×10^{-2} mSv), which is below the 15 mrem (0.15 mSv) dose criterion in Appendix I to 10 CFR Part 50 (TN249).

<u>North Anna Unit 2 in 2021</u>

- The air dose due to noble gases with resulting gamma radiation in gaseous effluents was 8.75×10^{-6} mrad (8.75×10^{-8} milligray), which is well below the 10 mrad (0.1 milligray) dose criterion in Appendix I to 10 CFR Part 50 (TN249).
- The air dose from beta radiation in gaseous effluents from North Anna Unit 2 was 7.31×10^{-6} mrad (7.31×10^{-8} milligray) dose, which is well below the 20 mrad (0.2 milligray) dose criterion in Appendix I to 10 CFR Part 50 (TN249).
- The critical organ dose to an offsite member of the public from radiation in gaseous effluents as a result of iodine-131, iodine-133, hydrogen-3, and particulates with greater than 8 day half-lives was 1.40 mrem (1.40×10^{-2} mSv), which is below the 15 mrem (0.15 mSv) dose criterion in Appendix I to 10 CFR Part 50 (TN249).

In the values cited above, similar to the analysis of liquid waste effluent doses in Section 2.1.4.2, Dominion's reported air and maximum organ gaseous effluent doses for the entire facility were evenly divided between North Anna Units 1 and 2. The review of North Anna's radioactive gaseous effluent control program showed radiation doses to members of the public that were well below NRC and the EPA's radiation protection standards contained in Appendix I to 10 CFR Part 50 (TN249), 10 CFR Part 20 (TN283), and 40 CFR Part 190 (TN739). The NRC staff observed no adverse trends in the dose levels over the 5 years reviewed.

During the SLR term, Dominion will continue to perform routine nuclear power plant refueling and maintenance activities. Based on Dominion's past performance operating the radioactive waste system to maintain ALARA doses from radioactive gaseous effluents, the NRC staff expects similar performance during the license renewal term.

2.1.4.3 Radioactive Solid Waste Management

North Anna's solid waste disposal system provides for hold-up, packaging, and storage of radioactive waste that will subsequently be shipped offsite to radwaste processors. These activities reduce the amount of waste shipped for offsite disposal. Solid radioactive wastes are logged, processed, packaged, and stored for subsequent shipment and offsite burial by the solid radioactive waste management system. Solid radioactive wastes and potentially radioactive wastes include sludges, spent resin, spent filter cartridges, and miscellaneous solid materials resulting from station operation and maintenance, such as contaminated rags, paper, and equipment parts.

Spent resin material is transferred as slurry for dewatering and shipment in high-integrity containers, which are placed in shielded shipping casks. Within the spent resin facilities, located in the decontamination building, spent resin from the nuclear power plant's ion exchangers is collected in shielded resin hold-up tanks where the transfer system flushes the resin from the hold-up tank. The resin is then dewatered and transferred to a high-integrity container for shipment to a burial site. Spent filter cartridges are placed in prefabricated metal containers and placed in an appropriately shielded location prior to shipment. Solid non-compactible and compactible trash is placed in appropriate containers and shipped to an offsite facility for compacting. A storage area in the waste storage facility serves as a staging area for waste ready for shipment to offsite radwaste processing and disposal facilities.

2.1.4.4 Radioactive Waste Storage

At North Anna, low-level radioactive waste (LLRW) is stored temporarily onsite at a low-level waste storage facility before being shipped offsite for processing or disposal at licensed LLRW treatment and disposal facilities. As indicated in Dominion's ER and discussed with the NRC staff at the remote audit, North Anna has sufficient existing capability to store all generated LLRW onsite. No additional construction of onsite storage facilities is necessary for LLRW storage during the period of extended operation.

North Anna Units 1 and 2 store spent fuel in a spent fuel pool and in an onsite independent spent fuel storage installation (ISFSI). The ISFSI safely stores spent fuel onsite in licensed and approved dry cask storage containers. The North Anna ISFSI is licensed under 10 CFR Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste" (TN4884). The ISFSI license was renewed by the NRC in February 2018 (83 FR 6242 TN8370); the ISFSI license renewal included a site-specific environmental assessment and finding of no significant impact, in that renewal of the ISFSI license will not significantly affect the quality of the human environment (83 FR 4932-TN8373).

The North Anna ISFSI currently has three spent fuel storage pads, each of which can accommodate 28 concrete-and-steel storage casks, for a total of 84 casks. Dominion stated in the ER that it has no current plans to add additional storage pads (VEPCO 2020-TN8099). Therefore, the NRC staff does not consider an expansion of the ISFSI in this EIS. The NRC staff notes, however, that the impacts of onsite storage of spent nuclear fuel during the period of extended operation have been determined to be SMALL, as stated in 10 CFR Part 51 (TN250), Appendix B, Table B-1; see also, NUREG-2157, *Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel* (NRC 2014-TN4117).

2.1.4.5 Radiological Environmental Monitoring Program

Dominion maintains a REMP to assess the radiological impact, if any, to the public and the environment from North Anna operations. The REMP measures the aquatic, terrestrial, and atmospheric environment for ambient radiation and radioactivity. Monitoring is conducted for the following: direct radiation, air, precipitation, well water, river water, surface water, milk, food products and vegetation (such as edible broad leaf vegetation), fish, silt, and shoreline sediment. The REMP also measures background radiation (i.e., cosmic sources, global fallout, and naturally occurring radioactive material, including radon).

In addition to the REMP, Dominion established a North Anna onsite groundwater protection initiative program in accordance with NEI 07–07, “Industry Ground Water Protection Initiative” (NEI 2007-TN1913). This program monitors the onsite nuclear power plant environment to detect leaks from nuclear power plant systems and pipes containing radioactive liquid. Section 3.5.2.3, “Groundwater Quality,” of this EIS contains information on North Anna’s groundwater protection initiative program.

As described in Section 2.1.4.1, the NRC staff reviewed 5 years of radioactive effluent release data from 2017 through 2021 (VEPCO 2018-TN8391, VEPCO 2019-TN8392, VEPCO 2020-TN8393, VEPCO 2021-TN8394, VEPCO 2022-TN8476). The NRC staff looked for indications of adverse trends (e.g., increasing radioactivity levels) over the most recently available sampling periods (2017–2021). For this 5-year period, no gamma-emitting isotope detections were reported; however, tritium in excess of the Dominion-established threshold (5,000 picocuries per liter [pCi/L]) has been detected in the groundwater in the reactor containment area (Section 3.5.2.3). Based on monitoring and groundwater flow directions, tritium in groundwater has not migrated beyond the reactor containment areas. Section 3.5.2.3 also contains a historical description of tritium concentrations in groundwater and known spills of water containing tritium (see “Radiological Spills” and “Tritium in Groundwater”).

There is no evidence of tritium in groundwater migrating offsite toward Lake Anna or the surrounding aquifers. The stratigraphy, hydrogeologic characteristics and groundwater flow gradients will likely prevent tritium from reaching Lake Anna and any surrounding aquifers. While tritium concentrations in groundwater sampled at some monitoring wells are above background or threshold concentrations, all samples remain below the EPA established drinking water maximum contaminant level of 20,000 pCi/L.

Based on its review of this information as described in Section 3.5.2.3 of this EIS, the NRC staff found no apparent increasing trend in concentration or pattern indicating either a new inadvertent release or persistently high tritium concentrations that might indicate an ongoing inadvertent release from North Anna. With the North Anna groundwater monitoring program in place, Dominion should readily detect any future leaks. Monitoring for spills assures that any spill is identified, closely scrutinized, characterized, and remediated. The monitoring data show that there were no significant radiological impacts to the environment from North Anna operations.

2.1.5 Nonradioactive Waste Management Systems

Section 2.1.5 of NUREG-1437, Supplement 7 describes North Anna's nonradioactive waste systems (NRC 2002-TN8296: Section 2.1.5, p. 2-12 to 2-13). Section E2.2.7 of Dominion's ER provides an expanded description of North Anna's nonradioactive waste system (VEPCO 2020-TN8099, Section E2.2.7: p. E-2-26 to E-2-46). Section 4.11.5 of Dominion's ER Supplement 1 (VEPCO 2022-TN8270) provides further information on North Anna's nonradioactive waste storage and disposal. This information is incorporated here by reference, with key information summarized below and in the following subsections.

Like any other industrial facility, nuclear power plants generate wastes that are not contaminated with either radionuclides or hazardous chemicals. North Anna generates nonradioactive waste as a result of nuclear power plant maintenance, cleaning, and operational processes. Dominion manages wastes in accordance with applicable Federal and State regulations as implemented through its corporate procedures. North Anna generates and manages the following types of nonradioactive waste:

- Hazardous Wastes: North Anna is classified as a small-quantity hazardous waste generator. The amounts of hazardous wastes generated are only a small percentage of the total wastes generated. These generally consist of paint wastes, spent and off-specification (e.g., shelf-life expired) chemicals, gun cleaning rags with lead residue, and occasional project-specific wastes. Table E2.2-2 in the ER provides a list and the amounts of hazardous waste (VEPCO 2020-TN8099).

- Nonhazardous Wastes: These generally include glycol and antifreeze (state specific), used polishing resin, nonhazardous paint, coatings, sealants, lubricants, grease, two-part epoxies, and fire barrier foam. Recycled waste typically consists of scrap metal, batteries, and used oil. Municipal waste is disposed of at the local permitted solid waste management facility. Table E2.2-2 in Dominion's ER provides a list and the amounts of nonhazardous waste (VEPCO 2020-TN8099).

- Universal Wastes: These typically consist of used oil, fluorescent lamps, batteries, mercury devices, and electronics (state specific) (VEPCO 2020-TN8099).

Dominion maintains a list of waste vendors that it has approved for use across the entire company to remove and dispose of the identified wastes offsite (VEPCO 2020-TN8099).

2.1.6 Utility and Transportation Infrastructure

The utility and transportation infrastructure at nuclear power plants typically interfaces with public infrastructure systems available in the region. Such infrastructure includes utilities, such as suppliers of electricity, fuel, and water; as well as roads and railroads that provide access to the site. The following sections briefly describe the existing utility and transportation infrastructure at North Anna. Site-specific information in this section is derived from Dominion's ER unless otherwise cited.

2.1.6.1 Electricity

Nuclear power plants generate electricity for other users; however, they also use electricity to operate. Offsite power sources provide power to engineered safety features and emergency equipment in the event of a malfunction or interruption of power generation at the nuclear power plant. Planned independent backup power sources provide power in the event that power is interrupted from both the nuclear power plant itself and offsite power sources.

2.1.6.2 Fuel

North Anna operates with low-enriched uranium dioxide fuel. With the NRC approval of optimized ZIRLO cladding fuel usage, Dominion operates the reactor cores at up to a maximum fuel discharge burnup rate of 60,000 megawatt-days per metric ton uranium (MWd/MTU) (i.e., the lead rod average burnup limit is 60,000 MWd/MTU). Refueling occurs approximately every 18 months. Dominion stores spent fuel in the spent fuel pool in the fuel handling building or in the ISFSI. As noted above, currently, the North Anna ISFSI includes three spent fuel storage pads, that can accommodate a total of 84 concrete-and-steel storage casks (VEPCO 2020-TN8099).

2.1.6.3 Water

In addition to cooling and auxiliary water, North Anna uses potable water for nuclear power plant personnel sanitary and everyday activities (e.g., drinking, showering, cleaning, doing laundry, operating toilets, and operating eye washes). In this EIS, Section 2.1.3, “Cooling and Auxiliary Water Systems,” describes the North Anna industrial water systems.

2.1.6.4 Transportation Systems

Nuclear power plants are served by controlled access roads that are connected to U.S. highways and Interstate highways. In addition to roads, many nuclear power plants also have railroad connections for moving heavy equipment and other materials. Nuclear power plants located on navigable waters may have facilities to receive and ship loads on barges. In the next chapter, Section 3.9.6, “Local Transportation,” describes the North Anna transportation systems.

2.1.6.5 Power Transmission Systems

For initial license renewal and SLR, the NRC evaluates, as part of the proposed action, the continued operation of the North Anna power transmission lines that connect to the substation where it feeds electricity into the regional power distribution system. The transmission lines that are in scope for the North Anna SLR environmental review are onsite and are not accessible to the general public. The NRC also considers the continued operation of the transmission lines that supply outside power to the nuclear power plant from the grid. Section 3.10.4, “Electromagnetic Fields,” in the next chapter, describes these transmission lines.

2.1.7 Nuclear Power Plant Operations and Maintenance

Maintenance activities at North Anna include inspection, testing, and surveillance to maintain the current licensing basis of the facility and to ensure compliance with environmental and safety requirements. These activities include in-service inspections of safety-related structures, systems, and components; quality assurance and fire protection programs; and radioactive and nonradioactive water chemistry monitoring.

Additional programs include those implemented to meet technical specification surveillance requirements and those implemented in response to NRC generic communications. Such additional programs include various periodic maintenance, testing, and inspection procedures necessary to manage the effects of aging on structures and components. Certain program activities are performed during the operation of the units, whereas others are performed during 18-month scheduled refueling outages (VEPCO 2020-TN8099).

2.2 Proposed Action

As stated in Section 1.1, the NRC's proposed Federal action is to decide whether to renew the North Anna operating licenses for an additional 20 years beyond the expiration dates of the current renewed licenses. Section 2.2.1 provides a description of normal nuclear power plant operations during the SLR term.

2.2.1 Nuclear Power Plant Operations during the Subsequent License Renewal Term

Nuclear power plant operation activities during the SLR term would be the same as, or similar to, those occurring during the current license term.

Section 2.1, "Description of Nuclear Power Plant Facility and Operation," describes some of the general types of activities that are carried out during nuclear power plant operations. Normal activities during operation of a nuclear power plant include:

- reactor operation
- waste management
- cooling water intake and discharge
- nuclear fuel receipt and storage
- spent fuel storage security
- office and clerical work; possible laboratory analysis
- surveillance, monitoring, and maintenance
- refueling and other outages

As part of its SLR application, Dominion submitted an ER. Dominion's ER states that North Anna will continue to operate during the SLR term in the same manner as it would during the current renewed license term except for additional aging management programs, as necessary. Such programs would address structure and component aging in accordance with 10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants" (TN4878).

2.2.2 Refurbishment and Other Activities Associated with License Renewal

Refurbishment activities include replacement and repair of major structures, systems, and components. Most major refurbishment activities are actions that would typically take place only once in the life of a nuclear power plant, if at all. For example, replacement of PWR steam generator systems is a refurbishment activity. Refurbishment activities may have an impact on the environment beyond those that occur during normal operations and may require evaluation, depending on the type of action and the nuclear power plant's specific design.

In preparation for its subsequent license renewal application, Dominion evaluated major structures, systems, and components in accordance with 10 CFR 54.21, "Contents of Application—Technical Information," to identify major refurbishment activities necessary for the continued operation of North Anna during the proposed 20-year SLR period of extended operation (VEPCO 2020-TN8099).

Dominion did not identify any major refurbishment activities necessary for the continued operation of North Anna beyond the end of the existing renewed operating licenses (VEPCO 2020-TN8099).

2.2.3 Termination of Nuclear Power Plant Operations and Decommissioning after the License Renewal Term

NUREG-0586, Supplement 1, Volumes 1 and 2, Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Regarding the Decommissioning of Nuclear Power Reactors (the decommissioning GEIS) (NRC 2002-TN7254), describes the environmental impacts of decommissioning. The majority of nuclear power plant operations activities would cease with reactor shutdown. Some activities (e.g., security and oversight of spent nuclear fuel) would remain unchanged, whereas others (e.g., waste management, administrative work, laboratory analysis, surveillance, monitoring, and maintenance) would continue at reduced or altered levels. Systems dedicated to reactor operations would cease. However, if these systems are not removed from the site after reactor shutdown, their physical presence may continue to impact the environment. Impacts associated with dedicated systems that remain in place, or with shared systems that continue to operate at normal capacities, would remain unchanged.

Decommissioning could occur whether North Anna is shut down at the expiration of its current renewed operating licenses or at the end of subsequent license renewal periods of extended operation, 20 years later. The environmental impacts of decommissioning would be similar in either event.

2.3 Alternatives

As stated above, NEPA requires the NRC to consider reasonable alternatives to the proposed action of renewing the North Anna Units 1 and 2 operating licenses. For a replacement energy alternative to be reasonable, it must be either (1) commercially viable on a utility scale and operational before the reactor ’s operating license expires or (2) expected to become commercially viable on a utility scale and operational before the reactor’s operating license expires.

The first alternative to the proposed action, renewing the North Anna operating licenses, is for the NRC to not issue the licenses. This is called the no-action alternative and is described in Section 2.3.1. In addition to the no-action alternative, this section discusses two reasonable replacement energy alternatives. As described in Section 2.3.2, these alternatives would seek to replace North Anna’s generating capacity by meeting the region’s energy needs through other means or sources.

2.3.1 No-Action Alternative

At some point, all operating nuclear power plants will permanently cease operations and undergo decommissioning. Under the no-action alternative, the NRC does not issue the subsequent renewed operating licenses for North Anna and the units would shut down at or before the expiration of the current renewed licenses on April 1, 2038 (Unit 1), and August 21, 2040 (Unit 2). The NRC expects the impacts to be relatively similar, whether they occur at the end of the current renewed license term (i.e., after 60 years of operation) or at the end of the subsequent renewed license terms (e.g., after 80 years of operation).

After permanent reactor shutdown, nuclear power plant operators will initiate decommissioning in accordance with 10 CFR 50.82, “Termination of License” (TN249). The decommissioning GEIS (NUREG-0586) (NRC 2002-TN7254) describes the environmental impacts from decommissioning a nuclear power plant and related activities. The analysis in the decommissioning GEIS bounds the environmental impacts of decommissioning when Dominion terminates reactor operations at North Anna. A licensee in decommissioning must assess in its post-shutdown decommissioning activities report submitted to the NRC whether there are planned decommissioning activities with reasonably foreseeable environmental impacts that are not bounded in previous EISs. Section 3.14.2, “Terminating Plant Operations and Decommissioning,” describes the incremental environmental impacts of SLR on decommissioning activities.

Termination of reactor operations at North Anna would result in the total cessation of electrical power production by North Anna Units 1 and 2. Unlike the replacement energy alternatives described in Section 2.3.2, the no-action alternative does not meet the purpose and need of the proposed action, as described in Section 1.2, because the no-action alternative does not provide a means of delivering baseload power to meet future electric system needs. Assuming that a need currently exists for the electrical power generated by North Anna, the no-action alternative would likely create a need for replacement energy.

2.3.2 Replacement Power Alternatives

The following sections describe replacement energy alternatives. The potential environmental impacts of these alternatives are described in Chapter 3. Although NRC’s authority only extends to deciding whether to renew North Anna Units 1 and 2 operating licenses, these replacement energy alternatives represent possible options for energy-planning decision-makers to consider if the operating licenses are not renewed.

In evaluating replacement energy alternatives, the NRC considered energy technologies in commercial operation, as well as technologies likely to be commercially available by the time the current renewed operating licenses expire. Because energy technologies continually evolve in capability and cost, and because regulatory structures change to either promote or impede the development of certain technologies, the staff’s evaluation determined which replacement energy alternatives are likely to be available and commercially viable when the North Anna renewed operating licenses expire.

Dominion’s ER describes possible replacement energy alternatives. In addition, the NRC staff’s alternatives analysis considered information from the following sources:

- U.S. Department of Energy’s (DOE), U.S. Energy Information Administration (EIA)
- other offices within the DOE
- EPA
- other Federal agency and national laboratory publications
- industry sources and publications

In total, the NRC staff considered 16 replacement energy alternatives. Of these, 14 of the alternatives were eliminated from detailed study, leaving 2 replacement energy alternatives. These two alternatives are described in Sections 2.3.2.1 and 2.3.2.2. Alternatives that could not provide the equivalent of North Anna’s current generating capacity were eliminated from detailed study as were alternatives whose costs or benefits could not justify inclusion in the range of reasonable alternatives. Alternatives not likely to be constructed and operational by the time the North Anna operating licenses expire in 2038 (Unit 1) and 2040 (Unit 2) were also eliminated from detailed study.

To ensure that the replacement energy alternatives are consistent with State or regional energy policies, the NRC reviewed energy-related statutes, regulations, and policies in the North Anna region. Accordingly, alternatives that would conflict with these requirements were eliminated from further consideration. Section 2.4 briefly describes the 14 alternatives eliminated from detailed study and provides the basis for their elimination:

- Alternatives to the proposed action:
  - new nuclear (small modular reactors)
  - combination alternative (solar, offshore wind, small modular reactors, and demand-side management)
- Alternatives eliminated from detailed study:
  - solar power
  - wind power
  - biomass power
  - demand-side management
  - hydroelectric power
  - geothermal power
  - wave and ocean energy
  - municipal solid waste-fired power
  - natural gas-fired power
  - petroleum-fired power
  - coal-fired power
  - fuel cells
  - purchased power
  - delayed retirement of other generating facilities

The NRC staff considered the reasonably foreseeable impacts of each alternative. The NRC assigns a significance level of SMALL, MODERATE, or LARGE for most site-specific issues. For ecological resources subject to the ESA, as amended (16 U.S.C. 1531 et seq.; TN1010) and the MSA, as amended (16 U.S.C. 1801 et seq.; TN7841); and historic and cultural resources subject to the NHPA, as amended (54 U.S.C. 300101 et seq.; TN4157), the impact significance determination language is specific to the authorizing legislation. The order in which this EIS presents the different alternatives does not imply increasing or decreasing level of impact; nor does the order of presentation imply that an energy-planning decision-maker would be more (or less) likely to select any given alternative.

Region of Influence

Dominion's service territory within Virginia contains the company's largest proportion of generation facilities and constitutes the region of influence (ROI) for the NRC staff's analysis of North Anna replacement power alternatives. If the NRC does not issue subsequent renewed licenses, procurement of replacement power for North Anna may be necessary. The power station is located on Lake Anna in Louisa County, Virginia, with a portion of the site extending into neighboring Spotsylvania County, Virginia. North Anna is predominately owned and operated by Dominion. The Old Dominion Electric Cooperative also has a partial (approximately 12 percent) ownership in the nuclear power plant (VEPCO 2020-TN8099, VEPCO 2021-TN8179). Dominion provides electricity to customers in Virginia and northeastern North Carolina, and is also a member of PJM Interconnection, the operator of the wholesale electric grid in the Mid-Atlantic region of the United States.

In 2019, electric generators in Virginia had a net summer generating capacity of approximately 28,000 megawatts (MW). This capacity included units fueled by natural gas (49 percent), hydroelectric and pumped storage (15 percent), nuclear power (13 percent), coal (10 percent), and petroleum (8 percent). Biomass and solar sources comprised the balance of generating capacity in Virginia (EIA 2021-TN8378).

The electric industry in Virginia generated approximately 97,000 gigawatt hours (GWh) of electricity in 2019. This electrical production was dominated by natural gas (60 percent), and nuclear power (31 percent). Biomass, coal, hydroelectric, petroleum, and solar energy sources collectively fueled the remaining 9 percent of this electricity (EIA 2021-TN8353).

In the United States, natural gas-fired generation rose from 16 percent of the total electricity generated in 2000 to 37 percent in 2019 (DOE/EIA 2020-TN7376). Given known technological and demographic trends, the EIA predicts that natural gas-fired generation in the United States will remain relatively constant through 2050, whereas electricity generated from renewable energy is expected to double from 21 percent of total generation to 42 percent over that period (EIA 2021-TN8354). However, fossil fuel and renewable energy levels within the North Anna ROI may not follow nationwide forecasts, and uncertainties in U.S. energy policies and the energy market could affect forecasts. In particular, the implementation of policies aimed at reducing greenhouse gas (GHG) emissions could have a direct effect on fossil fuel-based generation technologies (Patel 2018-TN8416; EIA 2020-TN8352). For example, the Commonwealth of Virginia recently passed the Virginia Clean Economy Act (VCEA). The legislation, which became effective in July 2020, mandates that Dominion's electric generation be 100 percent carbon-free by 2045; this would require the closure of all carbon-emitting power plants that generate electricity, including power plants that generate electricity using natural gas, unless a waiver has been sought by the utility and granted by the State, to allow the continued operation of such power plants. It further requires that several coal-fired and oil-fired power plants within the State retire by the end of 2024, followed by the retirement of several biomass power plants by 2028 (Virginia General Assembly-TN8532). Also in 2020, Dominion announced a significant expansion of its GHG emissions reduction goals, establishing a new companywide commitment to achieve net-zero carbon dioxide (CO_2) and methane (CH_4) emissions by 2050 (VEPCO 2020-TN8099).

As discussed in Section 2.4, the NRC staff considered but eliminated from detailed study each of the 14 alternatives listed above, due to their inability to satisfy one or more of these objectives or legal requirements. The remainder of this section describes two replacement energy alternatives to the proposed action:

- new nuclear (small modular reactor) alternative (Section 2.3.2.1)
- combination alternative of solar power, offshore wind power, new nuclear (small modular reactor [SMR]) power, and demand-side management (Section 2.3.2.2)

Table 2-1 summarizes key characteristics of the replacement energy alternatives.

Table 2-1 Overview of Replacement Energy Alternatives

Alternative	New Nuclear (Small Modular Reactor)	Combination (Solar, Offshore Wind, Small Modular Reactor, and Demand-Side Management)
Summary	Five small modular reactor units for a total of approximately 1,900 MWe	800 MWe from solar, 500 MWe from offshore wind, 400 MWe from small modular reactor generation, and 200 MWe from demand-side management
Location	Within the North Anna site on developed and undeveloped land. Would use North Anna's existing transmission lines and some existing infrastructure (VEPCO 2020-TN8099)	The solar component would be located at multiple sites distributed across the ROI, offsite of the North Anna site. The wind component would be located off the Virginia coast in Federal waters designated for offshore wind development. The small modular reactor component would be located within the North Anna site on developed and undeveloped land (VEPCO 2020-TN8099). Assumes demand-side management energy savings from within Dominion's service territory.
Cooling System	Closed cycle with mechanical draft cooling towers Cooling water withdrawal—63 mgd Consumptive water use—44 mgd (NRC 2018-TN7244)	The small modular reactor unit would use closed-cycle cooling systems with mechanical draft cooling towers. Cooling water withdrawal—13 mgd Consumptive water use—9.2 mgd (NRC 2018-TN7244). No cooling system would be required for solar and wind facilities or for demand-side management.
Land Required	Approximately 200 ac (81 ha) area west of and adjacent to the existing North Anna facilities (VEPCO 2020-TN8099).	Solar facilities would collectively require approximately 20,000 ac (8,000 ha) (NRC 2013-TN2654). Offshore wind facilities would be sited within an approximately 72 square-nautical mile (62,000 ac) grid (BOEM 2020-TN7494). Small modular reactor facilities would require approximately 36 ac (14 ha) (NuScale Power LLC 2022-TN7327). Demand-side management requires no land.
Work Force	Peak construction—2,600 workers Operations—1,200 workers (NRC 2018-TN7244)	The solar, offshore wind, and small modular reactor units would collectively require approximately 3,100 workers during peak construction and 490 workers during operations. (BOEM 2020-TN7494; BLM 2019-TN8386; NRC 2018-TN7244; DOE 2011-TN8387)

Note: ac = acres, ha = hectares, mgd = million gallons per day, MWe = megawatts electric, ROI = region of influence.

2.3.2.1 New Nuclear Alternative (Small Modular Reactor)

Construction of a new nuclear power plant would be a reasonable replacement energy alternative to North Anna SLR. Nuclear generation currently accounts for approximately 34 percent of the electricity produced in Virginia (EIA 2021-TN8353). In addition to North Anna, two other nuclear power plants operate within the ROI: Surry Power Station, Units 1 and 2, are located approximately 86 miles (138 km) to the southeast.

For the new nuclear alternative, multiple SMRs would be installed at North Anna. Small modular reactors, in general, are light-water reactors (LWRs) that use water for cooling and enriched uranium for fuel in the same manner as conventional, large LWRs currently operating in the United States. SMR modules typically generate 300 megawatts electric (MWe) or less, compared to today's larger nuclear reactor designs, that can generate 1,000 MWe or more per reactor. However, their smaller size means that several SMRs can be bundled together in a single containment. Their smaller size also means greater siting flexibility, because they can fit in locations not large enough to accommodate a conventional nuclear reactor (NRC 2020-TN7241; DOE 2022-TN7250). The design features of an SMR can include below grade containment and inherent safe shutdown features, longer station blackout coping time without external intervention, and core and spent fuel pool cooling without the need for active heat removal.

SMR power generating facilities are also designed to be deployed in an incremental fashion to meet the power generation needs of a service area, in which generating capacity can be added in increments to match load growth projections (NRC 2018-TN7244). For purposes of analysis, the SMR facility would replace North Anna. Although SMR modules typically generate 300 MWe or less, for this analysis the NRC staff assumed the use of a slightly larger (400 MWe) module based upon an established generic SMR nuclear power plant design and representative construction and operating parameters derived from several commercial designs (NRC 2018-TN7244). In its ER, Dominion analyzed replacing 1,672 MWe of North Anna's electrical generation. This value reflects Dominion Energy's ownership portion of the nuclear power plant's total licensed capacity of approximately 1,892 MWe, but not the approximately 11.6 percent portion under ownership of the Old Dominion Electric Cooperative (VEPCO 2020-TN8099, VEPCO 2021-TN8179). However, to account for replacing the full amount of North Anna's generating capacity that would be subject to license renewal, the NRC staff assumed that the SMR facility would include five reactor modules (four 400-MWe modules and one 300-MWe module) with a total net generating capacity of approximately 1,900 MWe.

As indicated in Dominion's ER, the SMR facility footprint would be located within an approximately 200-ac (81-ha) area west of and adjacent to the existing North Anna facilities (VEPCO 2020-TN8099). This area was previously evaluated in the EIS for the early site permit (ESP) for the North Anna site (NRC 2006-TN8385), and the 2010 EIS for a combined license (COL) for North Anna Unit 3 (NRC 2010-TN6). It is comprised of approximately 120 ac (49 ha) of developed land and 80 ac (32 ha) of forested land (VEPCO 2020-TN8099). The SMR facilities would use a closed-cycle cooling system with mechanical draft cooling towers. This cooling system would withdraw approximately 63 million gallons per day (mgd) (240,000 cubic meters per day [m^3/d]) of water and consume 44 mgd (170,000 m^3/d) of water. Visible structures would include cooling towers and power block (NRC 2018-TN7244). Infrastructure upgrades may be required, however, the existing transmission line infrastructure would be sufficient to support the SMR (VEPCO 2020-TN8099).

2.3.2.2 Combination Alternative (Solar, Offshore Wind, Small Modular Reactor, and Demand-Side Management)

A combination of carbon-free replacement power generation technologies with demand-side management would be a reasonable alternative to North Anna SLR. The amount of energy derived from each type of power generation in this combination alternative could vary. For the purposes of analysis, solar photovoltaic power installations would supply 800 MWe, offshore wind facilities would supply 500 MWe, SMRs would supply 400 MWe, and energy efficiency initiatives (i.e., demand-side management) would provide 200 MWe of energy savings.

<u>Solar Photovoltaic</u>

Solar photovoltaic power generation uses solar panels to convert solar radiation into usable electricity. Solar cells are formed into solar panels that can then be linked into photovoltaic arrays to generate electricity. The electricity generated can be stored, used directly, fed into a large electricity grid, or combined with other electricity generators as a hybrid power plant. Solar photovoltaic cells can generate electricity whenever there is sunlight, regardless of whether the sun is directly or indirectly shining on the solar panels. Therefore, solar photovoltaic technologies do not need to directly face and track the sun. This capability has allowed solar photovoltaic systems to have broader geographical use than concentrating solar power (which relies on direct sun) (Ardani and Margolis 2011-TN2522).

The feasibility of solar energy serving as alternative baseload power depends on the location, value, accessibility, and constancy of solar radiation. Solar photovoltaic resources across Virginia are of average availability and range from 4.5 to 5.0 kilowatt hours per square meter per day ($kWh/m^2/day$) (NREL 2018-TN8350). Nationwide, growth in utility-scale solar photovoltaic facilities (greater than 1 MW) has resulted in an increase from 145 MW in 2009 to over 35,000 MW of installed capacity in 2019 (DOE/EIA Undated-TN7709).

Under this combination alternative, the NRC staff assumed that eight 400-MWe, utility-scale solar facilities would be used to provide replacement energy. Assuming a 25 percent capacity factor (DOE/EIA 2021-TN7722), the solar units collectively would have an approximate net generating capacity of 800 MWe.

Solar photovoltaic facilities require large areas of land for the solar panels, up to 6.2 ac (2.5 ha) per MWe (NRC 2013-TN2654). Therefore, based on this estimate, approximately 20,000 ac (8,000 ha) of land would be required to operate the eight solar power and storage facilities. Solar photovoltaic systems do not require water for cooling.

In its 2020 Integrated Resource Plan, Dominion identified its plans to increase solar power capacity and generation over the next 15 years (VEPCO 2020-TN8351). Because solar voltaic resources are of average availability in the North Anna ROI and solar photovoltaic technology is commercially available in the region, solar photovoltaic power generation would be a reasonable alternative when combined with other sources of power generation.

<u>Offshore Wind</u>

Wind-generated replacement power under this combination alternative would come from offshore wind farms located along Virginia’s Atlantic coast. Under this alternative, offshore wind, operating at an expected capacity factor of 50 percent (NREL 2020-TN8425), would require an installed capacity of 1,000 MWe.

Virginia has large areas off its Atlantic coast and in Chesapeake Bay with wind energy potential, but no utility-scale wind power generation currently exists in the State (EIA 2020-TN8352). Based on a planned expansion of offshore wind capabilities, the NRC staff considers that an additional installed capacity of 1,000 MWe can be reasonably attained by the time the renewed North Anna operating licenses expire in 2038 and 2040.

In December 2020, Dominion filed a construction and operations plan with the U.S. Bureau of Ocean Energy Management (BOEM) to build the 2,640-MW Coastal Virginia Offshore Wind commercial project, the largest planned offshore wind farm in the United States. This followed Dominion's completed construction of a two-turbine, 12-MW pilot portion of the project earlier that year. Dominion expects to begin construction of the commercial portion of the project in 2024 and to begin operations in 2026. Offshore wind generated power would be located in or near the Coastal Virginia Offshore Wind project area, in Federal waters approximately 30 miles (48 km) offshore of Virginia Beach, Virginia where Dominion has leased 113,000 ac (46,000 ha) for offshore wind development (BOEM 2021-TN8356; VEPCO 2020-TN8381).

Offshore wind turbine generators (WTGs) are substantially larger than those operated on land. From 2000 to 2020, offshore WTG sizes have grown from an installed average of 2 MW per turbine to recent designs capable of generating 14 MW per turbine (BOEM 2020-TN7494). In 2020, Dominion indicated that it had conditionally selected a 14-MW turbine model for developing its commercial offshore wind project (Patel 2020-TN8415). Offshore wind development would use this or a similar-sized turbine, which has a rotor diameter of 722 feet (ft) (222 meters [m]) and a total height of approximately 800 ft (245 meters) (Lake 2020-TN8426; Siemens Gamesa: Renewable Energy Undated-TN8427). Accordingly, to attain an installed capacity of 1,000 MWe would require the installation of 72 turbines.

Although offshore wind turbines can either be affixed to the seabed or free-floating, water depths associated with the Virginia's offshore wind energy areas are more suitable to fixed models, of which there are various foundation designs. Under this combination alternative, the 72 turbines would be constructed in a grid pattern approximately 1 nautical mile (1.9 km) apart using an affixed monopile design driven into the seafloor to depths of approximately 260 ft (80 m) (BOEM 2020-TN7494), and each turbine would be located in the center of each square nautical mile block to better isolate each turbine from passing vessels. Offshore construction impacts are projected to occur within a 95-ac (38.5-ha) temporary work area proximate to each turbine location (BOEM 2015-TN8399; VEPCO 2015-TN8400). The seabed surrounding each turbine foundation would be protected from ocean current erosion by placement of a permanent 3–6 ft (1–1.5 m) scour-protection rock bed covering approximately 1 ac (0.4 ha) (BOEM 2018-TN8428). Accordingly, the construction of the turbines supporting the offshore wind component would result in approximately 6,800 ac (2,800 ha) of temporary disturbance and 72 ac (29 ha) of permanent disturbance.

Additional disturbance would result from trenching activities associated with interconnecting the WTGs and exporting the power to onshore facilities. Available offshore and onshore infrastructure would be used (e.g., offshore electrical service platforms and cable trenches extending to onshore interfaces) associated with Dominion's current and planned development of the Coastal Virginia Offshore Wind project.

Because offshore wind turbines require ample spacing between one another to avoid inter-turbine air turbulence and allow for navigation by ocean vessels, the total area requirement of utility-scale wind farms is significantly larger than the amount of marine environment that would be directly disturbed. Under this alternative, approximately 72 square nautical miles would be required for an installed capacity of 1,000 MWe (BOEM 2020-TN7494).

In its 2020 Integrated Resource Plan, Dominion indicated that offshore wind generation is a major component of its strategy to meet standards mandated in the VCEA and that it plans to increase total offshore wind generation to more than 5,000 MW over the next 15 years (VEPCO 2020-TN8351, VEPCO 2020-TN8381). As discussed in Section 2.4.2, although it is unlikely that offshore wind power could fully replace North Anna's generation capacity, Virginia's offshore environment does offer considerable wind power potential, and offshore wind technologies are poised to become a commercially available option for providing electrical generating capacity in the ROI by the time the renewed North Anna operating licenses expire. Accordingly, the NRC staff considers that installation of offshore wind turbine generators would be a reasonable alternative to North Anna SLR when combined with other sources of power generation.

Small Modular Reactor

Under this combination alternative, a single-unit, 400-MWe SMR power plant would be installed at North Anna. The power plant would be similar in function and appearance to the new nuclear alternative described in Section 2.3.2.1. Although some infrastructure upgrades may be required in association with the SMR, existing transmission line infrastructure would be adequate to support this alternative. The SMR would be located within an approximately 200-acre (ac) (81-ha) area west of and adjacent to North Anna (VEPCO 2020-TN8099) but would require less land than the five-module SMR considered in Section 2.3.2.1.

The SMR nuclear power plant would use a closed-cycle cooling system with mechanical draft cooling towers, withdrawing approximately 13 mgd (50,000 m^3/d) of water and consume 9.2 mgd (35,000 m^3/d) of water (NRC 2018-TN7244). Visible structures would include cooling towers and power block (NRC 2018-TN7244).

Demand-Side Management

Energy conservation and efficiency programs are more broadly referred to as demand-side management. Demand-side management programs can include reducing energy demand through consumer behavioral changes or through altering the electricity load so as to not require the addition of new generating capacity. These programs can be initiated by utilities, transmission operators, States, or other load-serving entities.

Although Virginia does not have a mandatory energy efficiency resource standard, demand-side management programs represent a fundamental component of Dominion's 2020 Integrated Resource Plan (VEPCO 2020-TN8351). Therefore, for this analysis it is assumed that Dominion would implement these programs.

Under the combination alternative, demand-side management would be used to replace approximately 200 MWe of the electrical generation that North Anna currently provides. Dominion projects that by 2035, its demand-side management programs could potentially reduce electrical demand across Dominion Energy's service area by 383 MWe (VEPCO 2020-TN8351). Because estimates of reduced electrical demand involve considerable uncertainty, the NRC staff considered that the replacement of 200 MWe of North Anna output through demand-side management programs would be a reasonable assumption for the combination alternative.

2.4 Alternatives Considered but Eliminated

As stated above, the NRC staff eliminated 14 alternatives from detailed study due to resource availability and commercial or regulatory limitations. Many of these limitations will likely still exist when the current renewed North Anna operating licenses expire in 2038 (Unit 1) and 2040 (Unit 2). This section briefly describes the 14 alternatives as well as the reasons why they were eliminated from detailed study.

2.4.1 Solar Power

Solar power, including photovoltaic and concentrating solar power technologies, generates power from sunlight. Solar photovoltaic components convert sunlight directly into electricity using solar cells made from silicon or cadmium telluride. Concentrating solar power uses heat from the sun to boil water and produce steam. The steam drives a turbine connected to a generator to produce electricity (NREL Undated-TN7710).

Solar generators are considered an intermittent electrical power resource because their availability depends on exposure to the sun, also known as solar insolation. Insolation rates of solar photovoltaic resources in Virginia range from 4.5 to 5.0 kWh/m^2/day (NREL 2018-TN8350). With only 611 Mwe of utility-scale capacity installed across Virginia in 2020, solar photovoltaic power represents a small but increasing contribution to the Commonwealth of Virginia's electrical power generation (EIA 2020-TN8352).

To be considered viable, a utility-scale solar alternative must replace the amount of electrical power that North Anna currently provides. Assuming a capacity factor of 25 percent (DOE/EIA 2023-TN8957), approximately 7,600 MWe of additional solar energy capacity would need to be installed to replace the electricity generated by North Anna.

Accordingly, key design characteristics associated with the solar portion of the combination alternative presented in Table 2-1 and Section 2.3.2.2, could be scaled to suggest the relative impacts of using solar as a standalone technology to replace the North Anna generating. Utility-scale solar facilities require large areas of land for the solar panels. A utility-scale solar alternative within Dominion's service area would require more than 47,000 ac (19,000 ha) of land.

Because Dominion is already pursuing an aggressive solar strategy to offset current and forecasted fossil capacity reductions, it is expected that acquiring this much land would be difficult. In addition, difficulties in acquiring land and permitting new solar projects could worsen if localities and members of the public continue to raise objections to siting solar power facilities in their communities (VEPCO 2020-TN8351).

Based on this information, a utility-scale solar energy alternative would not be reasonable to North Anna SLR. However, a limited amount of solar power generation, in combination with other energy generating technologies, would be a reasonable alternative to North Anna SLR, as explained in Section 2.3.2.2.

2.4.2 Wind Power

As is the case with other renewable energy sources, the feasibility of wind energy providing baseload power depends on the location (relative to electricity users), value, accessibility, and constancy of the resource. Wind energy must be converted to electricity at or near the point where it is used, and there are limited energy storage opportunities available to overcome the intermittency and variability of wind resources.

The American Clean Power Association reports a total of more than 122,000 MW of installed wind energy capacity nationwide as of December 31, 2020. Approximately 200 MW of this wind energy capacity is installed within the ROI (see Section 2.3.2) (DOE Undated-TN8431). To be considered a reasonable replacement energy alternative to North Anna SLR, a wind power alternative must replace the amount of electrical power that North Anna provides. Assuming a capacity factor of 40 percent (NREL 2020-TN8425), land-based wind energy facilities would need to generate 4,750 MW to replace North Anna's generating capacity of 1,900 MWe. However, Virginia currently has no installed utility-scale wind energy capacity and only limited onshore wind potential available to support the development of future of land-based wind energy systems (EIA 2020-TN8352).

Increasing attention has been focused on developing offshore wind resources along the Atlantic coast. In 2016, a 30 MW project off the coast of Rhode Island become the first operating offshore wind farm in the United States (Orsted Undated-TN7705). No utility-scale offshore wind farms are currently in operation off the coast of Virginia (EIA 2020-TN8352). However, in 2020, Dominion completed construction of the Mid-Atlantic's first offshore wind demonstration project in Federal waters (BOEM 2021-TN8356; VEPCO 2020-TN8381). This two-turbine 12-MW demonstration project will help inform the planned 2,600 MW utility-scale development of the adjacent 113,000 ac (46,000 ha) wind energy area leased to Dominion for the Coastal Virginia Offshore Wind project, which is expected to commence operation in 2026 (BOEM 2021-TN8356; VEPCO 2020-TN8381).

Assuming a capacity factor of 50 percent for offshore wind farms (NREL 2020-TN8425), these power generating facilities would need to generate 3,800 MW to fully replace North Anna's generating capacity of 1,900 MWe. A utility-scale offshore wind alternative of this size would therefore require 272 wind turbines, and more than 270 square nautical miles (230,000 ac) (93,000 ha), which exceeds the area of the Federal waters off coastal Virginia that is designated for wind energy leasing. Because Dominion is pursuing an offshore wind strategy to offset current and forecasted fossil capacity reductions, it is expected that acquiring additional leases to support this level of offshore wind development would be difficult.

Given the amount of wind capacity required to replace North Anna, the intermittency of the resource, the limited amount of offshore Federal waters designated for wind energy leasing, and the status of wind development, a wind-only alternative—either land based, offshore, or some combination of the two—would be an unreasonable alternative to North Anna SLR. However, a limited amount of offshore wind power generation, in combination with other energy generating technologies, would be a reasonable alternative to North Anna SLR, as explained in Section 2.3.2.2 of this EIS.

2.4.3 Biomass Power

Biomass resources used for biomass fuel-fired power generation include agricultural residue, animal manure, wood waste from forestry and industry, residues from food and paper industries, municipal green waste, dedicated energy crops, and methane from landfills (IEA 2007-TN8436). Using biomass fuel-fired generation for baseload power depends on the geographic distribution, available quantities, constancy of supply, and energy content of biomass resources. For this analysis, biomass fuel would be combusted for power generation in the electricity sector.

In 2019, biomass fuel-fired power generation in the region had a total installed capacity of approximately 805 MW, and approximately 3 percent of the total power in the ROI (EIA 2021-TN8378, EIA 2021-TN8353). Dominion currently generates 51 MW of electricity from biomass fuel sources, the majority of that coming from the combustion of wood waste (VEPCO 2020-TN8099).

For utility-scale biomass electricity generation, technologies used for biomass energy conversion would be similar to the technology used in other fossil fuel-fired power plants, including the direct combustion of biomass fuel in a boiler to produce steam. Accordingly, biomass generation is considered a carbon-emitting technology and would be subject to the mandates of the VCEA.

Biomass fuel-fired power generation is generally more cost-effective when co-fired with coal-burning power plants (IEA 2007-TN8436). However, most biomass fuel-fired power plants generally only reach capacities of 50 MW, which means that replacing North Anna's 1,900 MWe, using only biomass fuel, would require 38 new power plants.

Increasing biomass fuel-fired power generation capacity by expanding or constructing 38 new units by the time North Anna's operating licenses expire in 2038 and 2040, respectively, is unlikely. For these reasons, biomass fuel-fired generation would not be a reasonable alternative to North Anna SLR.

2.4.4 Demand-Side Management

Demand-side management refers to energy conservation and efficiency programs that do not require the addition of new generating capacity. In general, residential electricity consumers have been responsible for the majority of peak load reductions, and participation in most demand-side management programs is voluntary.

Therefore, the existence of a demand-side management program does not guarantee that reductions in electricity demand will occur. Although the energy conservation or energy efficiency potential in the United States is substantial, there have been no instances where energy efficiency or conservation program alone has been implemented expressly to replace or offset a large baseload electrical power generation station.

Although Dominion has considered demand-side management measures as part of its resource planning efforts, it is unlikely that additional demand-side management measures alone would be sufficient to offset the electrical energy lost by the North Anna shutdown (VEPCO 2020-TN8099, VEPCO 2020-TN8351). Therefore, demand-side management programs alone would not be a reasonable alternative to North Anna SLR. However, in combination with other power generating technologies, demand side management would be a reasonable alternative, as described in Section 2.3.2.2.

2.4.5 Hydroelectric Power

There are currently about 2,000 operating hydroelectric power facilities in the United States. Hydropower technology captures flowing water and directs it to turbines and generators to produce electricity. There are three variants of hydroelectric power generation: (1) run-of-the-river (diversion) facilities that direct the natural flow of a river, stream, or canal through a hydroelectric power facility, (2) store-and-release facilities that block the flow of the river by using dams that cause water to accumulate in an upstream reservoir, and

(3) pumped-storage facilities that use electricity from other power sources to pump water to higher elevations during off peak hours to be released during peak load periods to generate electricity. Although Virginia is home to the largest hydroelectric storage facility in the United States—the 3,000-MW Bath County Pumped Storage Station—hydroelectric power accounts for less than 2 percent of Virginia's electric power production (EIA 2020-TN8352, EIA 2021-TN8353).

Although EIA projects that hydropower will remain a leading source of renewable power generation in the United States through 2040, there is little expected growth in large-scale hydropower capacity in the ROI (VEPCO 2020-TN8099; DOE/EIA 2013-TN2590). In addition, the potential construction of large new hydropower facilities has diminished because of public concern over flooding, habitat alteration and loss, and the impact on natural rivers.

Given the projected lack of growth in hydroelectric power, the competing demands for water resources, and public opposition to the environmental impacts from the construction of large hydroelectric power facilities, the use of hydroelectric power would not be a reasonable alternative to North Anna SLR.

2.4.6 Geothermal Power

Geothermal technologies extract heat from geologic formations to produce steam to drive steam turbine generators. Electricity production from geothermal energy has demonstrated 95 percent or greater capacity factors, making geothermal energy a potential source of baseload electric power. However, the feasibility of geothermal power generation to provide baseload power depends on the regional quality and accessibility of geothermal resources. Utility-scale power generation requires geothermal reservoirs with a temperature above 200°F (93°C). Utility-scale geothermal resources are concentrated in the Western United States, specifically Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming and most assessments of geothermal power generation have been concentrated in these States (DOE 2013-TN7698; USGS 2008-TN7697). There is currently no utility-scale geothermal power production in the ROI (NREL 2016-TN8469). Given its low potential, geothermal power generation would not be a reasonable alternative to North Anna SLR.

2.4.7 Wave and Ocean Energy

Ocean waves, currents, and tides are generally predictable and reliable, making them attractive candidates for potential renewable energy generation. Four major technologies can be used to harness wave energy: (1) terminator devices that range from 500 kilowatts to 2 MW, (2) attenuators, (3) point absorbers, and (4) overtopping devices (BOEM Undated-TN7696). Point absorbers and attenuators use floating buoys to convert wave motion into mechanical energy, driving generators to produce electricity. Overtopping devices trap a portion of a wave at a higher elevation than the sea surface; waves enter a tube and compress air that is then used to drive a generator, producing electricity. Some of these technologies are undergoing demonstration testing at commercial scales, but none are currently used to provide baseload power (BOEM Undated-TN7696). In the United States, there are currently several projects licensed or seeking permits, the largest of which is 20 MW (Duke Energy 2021-TN8897).

The Mid-Atlantic coast is characterized by substantial amounts of ocean wave energy (EPRI 2011-TN8442). However, wave and ocean energy technologies are still in their infancy and currently lack commercial application (VEPCO 2020-TN8099; EPRI 2011-TN8442). For these reasons, wave and ocean energy power generation would not be a reasonable alternative to North Anna SLR.

2.4.8 Municipal Solid Waste-Fired Power

Energy recovery from municipal solid waste converts nonrecyclable waste materials into usable heat, electricity, or fuel through combustion. There are three types of municipal solid waste combustion technologies that include mass burning, modular systems, and refuse-derived fuel systems. Mass burning is the method used most frequently in the United States. The heat released from combustion is used to convert water to steam, which is then used to drive turbine generators to produce electricity. Ash is collected and taken to a landfill, and particulates are captured through a filtering system (EPA 2023-TN8443).

Currently, 75 waste-to-energy power plants are in operation in 21 States, processing approximately 29 million tons of waste per year. These waste-to-energy power plants have an aggregate capacity of 2,725 MWe (Michaels and Krishnan 2019-TN7700). Although some power plants have expanded to handle additional waste and to produce more energy, only one new municipal solid waste combustion power plant has been built in the United States since 1995 (Maize 2019-TN7699). Because the average waste-to-energy power plant produces about 50 MWe, 38 waste-to-energy power plants would be necessary to provide the same level of electrical output as North Anna.

The decision to burn municipal waste to generate energy is usually driven by the need for an alternative to landfills rather than a need for energy. Stable supplies of municipal solid waste would be needed to support 38 new waste-to-energy power plants in the region. In addition, municipal solid waste combustion is a carbon-emitting technology subject to the mandates of the VCEA. Based on this information, municipal solid waste-to-energy power plants would not be a reasonable alternative to North Anna SLR.

2.4.9 Natural Gas-Fired Power

Historically, fossil fuel sources have accounted for the majority of electrical power generation in Virginia. In 2012, natural gas-fueled generation in Virginia exceeded that of coal for the first time. By 2015, natural gas-fired generation surpassed nuclear power generation (EIA 2020-TN8352). In 2019, natural gas represented approximately 49 percent of the installed generation capacity and 60 percent of the electrical power generated in Virginia (EIA 2021-TN8378, EIA 2021-TN8353).

Baseload natural gas combined-cycle power plants have proven reliability and can have capacity factors as high as 87 percent (DOE/EIA 2015-TN7717). A natural gas combined-cycle system generates electricity using a gas turbine that burns natural gas. A steam turbine uses the heat from gas turbine exhaust through a heat recovery steam generator to produce additional electricity. This two-cycle process has a high rate of efficiency because the natural gas combined-cycle system captures the exhaust heat that otherwise would be lost and reuses it. Like other fossil fuel-burning plants, natural gas power plants are a source of GHGs, including CO_2.

In its 2020 Integrated Resource Plan, Dominion indicated that up to 970 MW of new gas-fired generation could be necessary over the next 15 to 25 years to address potential system reliability issues resulting from the addition of significant renewable energy resources and the retirement of coal-fired facilities within its service territory (VEPCO 2020-TN8351). However, because the VCEA mandates that future power generation be carbon-free by 2045, gas-fired generation would not likely be available as a replacement power alternative during most of the proposed North Anna SLR period (i.e., through 2058 and 2060 for Units 1 and 2, respectively).

While the VCEA allows utilities to seek a waiver of this prohibition, to address grid reliability or security issues, it is difficult to predict whether Dominion would seek such a waiver in order to continue to operate a natural gas-fueled plant, whether it could successfully demonstrate that a waiver is warranted, or whether Virginia authorities would grant such a waiver request. Accordingly, at this time, natural gas-fired power plants would not be a reasonable alternative to North Anna SLR.

2.4.10 Petroleum-Fired Power

Petroleum-fired electricity generation accounted for less than 1 percent of Virginia's total electricity generation in 2019 (EIA 2021-TN8353). The variable costs and environmental impacts of petroleum-fired generation tend to be greater than those of natural gas-fired generation. The historically higher cost of oil has also resulted in a steady decline in its use for electricity generation, and the EIA forecasts no growth in capacity using petroleum-fired power plants through 2040 (DOE/EIA 2013-TN2590, DOE/EIA 2015-TN4585). The VCEA also mandates the retirement of all generation units that emit CO_2 as a byproduct of combustion by 2045, and Dominion's Integrated Resource Plan similarly anticipates no increase in the use of petroleum-fired power (VEPCO 2020-TN8351). Therefore, based on this information, petroleum-fired power generation would not be a reasonable alternative to North Anna SLR.

2.4.11 Coal-Fired Power

Although coal-fired power plants historically have been the largest source of electricity in the United States, both natural gas generation and nuclear energy generation surpassed coal-fired generation at the national level in 2020. Coal-fired electricity generation in the United States has continued to decrease as coal-fired units have been retired or converted to use other fuels and as the remaining units have been used less often (DOE/EIA 2021-TN7718). Virginia exemplifies this trend, with coal historically fueling the largest share of electricity generated in the Commonwealth until 2009, when coal's contribution fell below that of nuclear power (EIA 2020-TN8352). In 2019, coal-fired generation accounted for approximately 3.5 percent of all electricity generated in Virginia, a 48 percent decrease from 2000 levels (EIA 2021-TN8353).

Baseload coal-fired power units have proven their reliability and can routinely sustain capacity factors as high as 85 percent. Among the available technologies, pulverized coal boilers producing supercritical steam (supercritical pulverized coal boilers) have become increasingly common given their generally high thermal efficiencies and overall reliability.

Supercritical pulverized coal facilities are more expensive to build than subcritical coal-fired power plants but they consume less fuel per unit output. Integrated gasification combined cycle combines modern coal gasification technology with both gas turbine and steam turbine power generation. The technology is cleaner than conventional pulverized coal plants because some of the major pollutants are removed before combustion. Although several smaller, integrated gasification combined-cycle power plants have been in operation since the mid-1990s, large-scale projects have experienced setbacks and public opposition has hindered such projects from being fully integrated into the energy market.

The VCEA mandates that future power generation be carbon-free by 2045 and requires that several coal-fired plants within Virginia retire by the end of 2024. In its Integrated Resource Plan, Dominion proposes to continue to reduce coal-fired power generation from its fleet and it has no plans to add new coal-fired power generation to its energy production portfolio (VEPCO

2020-TN8351). Based on these considerations, coal-fired power plants would not be a reasonable alternative to North Anna SLR.

2.4.12 Fuel Cells

Fuel cells oxidize fuels without combustion and, therefore, without the environmental side effects of combustion. Fuel cells use a fuel (e.g., hydrogen) and oxygen to create electricity through an electrochemical process. The only byproducts are heat, water, and CO_2 (depending on the hydrogen fuel type. Hydrogen fuel can come from a variety of hydrocarbon resources including natural gas. As of October 2020, the United States had only 250 MW of fuel cell power generation capacity (DOE/EIA 2022-TN7828).

Currently, fuel cells are not economically or technologically competitive with other electricity generating alternatives. The EIA estimates that fuel cells may cost $6,639 per installed kilowatt (total overnight capital costs in 2021 dollars), which is high compared to other replacement energy alternatives (DOE/EIA 2022-TN7694). In June 2021, DOE launched an initiative to reduce the cost of hydrogen production to spur fuel cell and energy storage development over the next decade (DOE 2021-TN7693). However, it is unclear whether and to what degree this initiative will lead to increased future development and deployment of fuel cell technologies.

More importantly, fuel cell units used for power production are likely to be small (approximately 10 MW). The world's largest industrial hydrogen fuel cell power plant is a 50 MWe plant in South Korea (Larson 2020-TN8401). Using fuel cells to replace the power that North Anna provides would require the construction of approximately 190 units. Given limited deployment and the high cost of fuel cell technology, fuel cells would not be a reasonable alternative to North Anna SLR.

2.4.13 Purchased Power

Power may be purchased and imported from outside the region. Although purchased power would likely have little or no measurable impact, environmental impacts could occur where the power is being generated, which would vary depending on the technologies used to generate the power. As discussed in its ER, Dominion's purchased power initiatives are focused on acquisition of renewable sources, primarily in the form of solar non-utility generation. Reliance on solar non-utility generators to meet North Anna's power generation if the operating licenses are not renewed, combined with the transition to renewable sources mandated by the VCEA, would likely increase the cost of purchased power contracts (VEPCO 2020-TN8099).

Purchased power is generally economically adverse because, historically, the cost of generating power has been less than the cost of purchasing the same amount of power from a third-party supplier. Purchased power agreements also carry some inherent risk as compared to self-generated power, due to the risk that the supplier may not deliver all of the contracted power. Based on these considerations, purchased power would not provide a reasonable alternative to North Anna SLR.

2.4.14 Delayed Retirement of Other Generating Facilities

Delaying the retirement of a power plant enables it to continue supplying electricity. Because some power generators are required to adhere to regulations that require significant reductions in power plant emissions, some owners may opt to retire of older, less efficient units rather than incur the cost for compliance. Retirements may also be driven by low competing commodity prices (such as low natural gas prices), slow growth in electricity demand, and the EPA 's Mercury and Air Toxics Standards for fossil-fueled power plants (DOE/EIA 2015-TN4585; EPA 2020-TN8379).

In 2019, Dominion identified 4,570 MW of fossil fuel- or biomass-fired generation that had or could be retired between 2019 and 2025 (VEPCO 2020-TN8099). Dominion does not consider the continued operation of these carbon-emitting power plants to be a viable alternative for generating replacement power because it would not support VCEA mandates or Dominion's goals for lowering air emissions across its energy generation portfolio (VEPCO 2020-TN8099). Because of these considerations, delayed retirement of older power generating units would not provide a reasonable alternative to North Anna SLR.

2.5 Comparison of Alternatives

This section presents a comparison of the environmental impacts of the following three alternatives to the proposed action (North Anna SLR): (1) the no-action alternative; (2) new nuclear generation (small modular reactor); and (3) a combination of solar generation, offshore wind generation, SMR generation, and demand-side management. Chapter 3 describes the environmental impacts of the proposed action and the alternatives. Table 2-2 summarizes the environmental impacts of the proposed action (North Anna SLR) and the alternatives to SLR considered in this EIS.

The environmental impacts of the proposed action (renewing the North Anna operating licenses) would be SMALL for all impact categories. The two replacement energy alternatives have four identified environmental impacts that are greater than the impacts from the proposed action. In addition, replacement energy alternatives would result in construction impacts. If the NRC does not renew the North Anna operating licenses (no-action alternative), energy-planning decision-makers would have to choose a replacement power alternative similar to the ones evaluated in this EIS. Based on the review of the reasonable replacement energy alternatives, the no-action alternative, and the proposed action, the NRC staff concludes that the environmentally preferred alternative is the proposed SLR action. Therefore, the NRC staff's preliminary recommendation is that the North Anna operating licenses be renewed for the SLR PEO.

Table 2-2 Summary of Environmental Impacts of the Proposed Action and Alternatives

Impact Area (Resource)	North Anna Subsequent License Renewal (Proposed Action)	No-Action Alternative	New Nuclear Alternative (Small Modular Reactor)	Combination Alternative (Solar, Offshore Wind, Small Modular Reactor, and Demand-Side Management)
Land Use	SMALL	SMALL	SMALL to MODERATE	SMALL to LARGE
Visual Resources	SMALL	SMALL	SMALL to MODERATE	SMALL to LARGE
Air Quality	SMALL	SMALL	SMALL	SMALL
Noise	SMALL	SMALL	SMALL	SMALL to MODERATE
Geologic Environment	SMALL	SMALL	SMALL	SMALL to MODERATE
Surface Water Resources	SMALL	SMALL	SMALL	SMALL to MODERATE
Groundwater Resources	SMALL	SMALL	SMALL	SMALL

Table 2-2 Summary of Environmental Impacts of the Proposed Action and Alternatives (Continued)

Impact Area (Resource)	North Anna Subsequent License Renewal (Proposed Action)	No-Action Alternative	New Nuclear Alternative (Small Modular Reactor)	Combination Alternative (Solar, Offshore Wind, Small Modular Reactor, and Demand-Side Management)
Terrestrial Resources	SMALL	SMALL	SMALL	SMALL to LARGE
Aquatic Resources	SMALL	SMALL	SMALL	SMALL to LARGE
Special Status Species & Habitats	SEE NOTE[a]	SEE NOTE[b]	SEE NOTE[c]	SEE NOTE[c]
Historic and Cultural Resources	SEE NOTE[d]	SEE NOTE[e]	SEE NOTE[f]	SEE NOTE[f]
Socioeconomics	SMALL	SMALL to MODERATE	MODERATE to LARGE	MODERATE to LARGE
Transportation	SMALL	SMALL	MODERATE to LARGE	MODERATE to LARGE
Human Health	SMALL[g]	SMALL[g]	SMALL[g]	SMALL[g]
Environmental Justice	SEE NOTE[h]	SEE NOTE[h]	SEE NOTE[h]	SEE NOTE[h]
Waste Management and Pollution Prevention	SMALL[i]	SMALL[i]	SMALL	SMALL

(a) May affect but is not likely to adversely affect northern long-eared bat, tricolored bat, and monarch butterfly. No effect on essential fish habitat. No effect on sanctuary resources of National Marine Sanctuaries.

(b) Overall, the effects on federally listed species, critical habitat, and essential fish habitat (EFH) would likely be smaller under the no-action alternative than the effects under continued operation but would depend on the specific shutdown activities as well as the listed species, critical habitats, and designated EFH present when the no-action alternative is implemented.

(c) The types and magnitudes of adverse impacts to species listed in the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.; TN1010), designated critical habitat, and EFH would depend on the proposed alternative site, nuclear power plant design and operation, as well as listed species and habitats present when the alternative is implemented. Therefore, the NRC staff cannot forecast a level of impact for this alternative.

(d) Based on the location of historic properties within and near the area of potential effect, Tribal input, Dominion's administrative procedures, a site-specific cultural resource management plan, and no planned physical changes or ground-disturbing activities, the proposed action (SLR) would not adversely affect historic properties.

(e) Until the post-shutdown decommissioning activities report is submitted, the NRC staff cannot determine whether historic properties would be affected outside the existing industrial site boundary after the nuclear power plant is shut down.

(f) The impact determination of this alternative would depend on the specific location of the new facility. The Virginia Department of Historic Resources would need to be consulted prior to any ground-disturbing activities in undisturbed land areas at North Anna.

(g) The chronic effects of electromagnetic fields on human health associated with operating nuclear power and other electricity generating plants are uncertain.

(h) With the exception of the no-action alternative, there would be no disproportionate and adverse impacts to minority and low-income populations. For the no-action alternative, the loss of jobs and income could have an immediate socioeconomic impact. This could disproportionately affect minority and low-income populations that may have become dependent on these services.

(i) NUREG-2157, *Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel* (NRC 2014-TN4117), discusses the environmental impacts of spent fuel storage for the time frame beyond the licensed life for reactor operations.

3 AFFECTED ENVIRONMENT, ENVIRONMENTAL CONSEQUENCES, AND MITIGATING ACTIONS

3.1 Introduction

In conducting its review of the North Anna SLR application, the NRC staff defines and describes the environment that could be affected by the proposed action (subsequent renewal of the operating licenses authorizing an additional 20 years of reactor operation). The NRC staff evaluates the environmental consequences of the proposed action as well as reasonable alternatives to the proposed action and the no-action alternative.

The affected environment is the environment that currently exists at and around the North Anna site. Because existing environmental conditions are partially the result of past activities including the construction and operation of the nuclear power plant, this chapter evaluates how these activities have shaped the current environment. This chapter also describes reasonably foreseeable environmental trends. The effects of ongoing reactor operations at the site have become well established as environmental conditions have adjusted to the presence of the nuclear facility.[1] Sections 3.2 through 3.12 describe the affected environment at North Anna for each resource area, followed by an evaluation of the environmental consequences of the proposed action and alternatives to the proposed action. The environmental impacts of SLR are compared with those of the no-action alternative and replacement energy alternatives to determine whether the adverse environmental impacts are so great that it would be unreasonable to preserve the option of license renewal for energy-planning decision-makers.

The evaluation of environmental consequences includes the following:

- impacts associated with the proposed action—continued reactor operations such as those that have occurred during the current license terms
- impacts of various alternatives to the proposed action, including a no-action alternative (not renewing the operating licenses) and replacement energy alternatives: (1) new nuclear SMR and (2) combination alternative (new nuclear SMR, solar photovoltaic (PV), offshore wind, and demand-side management)
- impacts from the termination of nuclear power plant operations and decommissioning after the license renewal term
- impacts of the uranium fuel cycle
- impacts of postulated accidents (design-basis accidents and severe accidents)
- cumulative effects of the proposed action
- resource commitments associated with the proposed action, including unavoidable adverse impacts, the relationship between short-term use and long-term productivity, and irreversible and irretrievable commitment of resources
- new and potentially significant information on environmental issues related to the impacts of operation during the renewal term

[1] Where appropriate, the NRC staff has summarized referenced information or incorporated information by reference into this EIS. This allows the staff to focus on new and potentially significant information identified since initial license renewal of North Anna in 2003.

As explained in Section 1.4, the NRC evaluated environmental issues applicable to North Anna SLR. Table 3-1 lists the North Anna SLR environmental issues and the impact findings related to these issues. This EIS considers the environmental impacts of each license renewal issue on a site-specific basis. Section 1.4 provides the definitions of SMALL, MODERATE, and LARGE impact significance.

Table 3-1 Site-Specific Conclusions Regarding North Anna Subsequent License Renewal

Resource Area	Environmental Issue	Impacts
Land Use	Onsite land use[(a)]	SMALL
Land Use	Offsite land use[(a)]	SMALL
Visual Resources	Aesthetic impacts[(a)]	SMALL
Air Quality	Air quality impacts (all plants)[(a)]	SMALL
Air Quality	Air quality effects of transmission lines[(a)]	SMALL
Noise	Noise impacts[(a)]	SMALL
Geologic Environment	Geology and soils[(a)]	SMALL
Surface Water Resources	Surface water use and quality (non-cooling system impacts)[(a)]	SMALL
Surface Water Resources	Altered current patterns at intake and discharge structures[(a)]	SMALL
Surface Water Resources	Altered thermal stratification of lakes	SMALL
Surface Water Resources	Scouring caused by discharged cooling water[(a)]	SMALL
Surface Water Resources	Discharge of metals in cooling system effluent[(a)]	SMALL
Surface Water Resources	Discharge of biocides, sanitary wastes, and minor chemical spills[(a)]	SMALL
Surface Water Resources	Surface water use conflicts (plants with once-through cooling systems)[(a)]	SMALL
Surface Water Resources	Effects of dredging on surface water quality[(a)]	SMALL
Surface Water Resources	Temperature effects on sediment transport capacity[(a)]	SMALL
Groundwater Resources	Groundwater contamination and use (non-cooling system impacts)[(a)]	SMALL
Groundwater Resources	Groundwater use conflicts (plants that withdraw less than 100 gallons per minute [gpm])[(a)]	SMALL
Groundwater Resources	Radionuclides released to groundwater	SMALL
Terrestrial Resources	Effects on terrestrial resources (non-cooling system impacts)	SMALL
Terrestrial Resources	Exposure of terrestrial organisms to radionuclides[(a)]	SMALL
Terrestrial Resources	Cooling system impacts on terrestrial resources (plants with once-through cooling systems or cooling ponds)[(a)]	SMALL
Terrestrial Resources	Bird collisions with plant structures and transmission lines[(a)]	SMALL
Terrestrial Resources	Transmission line right-of-way (ROW) management impacts on terrestrial resources[(a)]	SMALL

Table 3-1 Site-Specific Conclusions Regarding North Anna Subsequent License Renewal (Continued)

Resource Area	Environmental Issue	Impacts
Terrestrial Resources	Electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)[a]	SMALL
Aquatic Resources	Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds)	SMALL
Aquatic Resources	Entrainment of phytoplankton and zooplankton (all plants)[a]	SMALL
Aquatic Resources	Thermal impacts on aquatic organisms (plants with once-through cooling systems or cooling ponds)	SMALL
Aquatic Resources	Infrequently reported thermal impacts (all plants)[a]	SMALL
Aquatic Resources	Effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication[a]	SMALL
Aquatic Resources	Effects of non-radiological contaminants on aquatic organisms[a]	SMALL
Aquatic Resources	Exposure of aquatic organisms to radionuclides[a]	SMALL
Aquatic Resources	Effects of dredging on aquatic resources[a]	SMALL
Aquatic Resources	Effects on aquatic resources (non-cooling system impacts)[a]	SMALL
Aquatic Resources	Impacts of transmission line right-of-way (ROW) management on aquatic resources[a]	SMALL
Aquatic Resources	Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses[a]	SMALL
Special Status Species and Habitats	Threatened, endangered, and protected species and essential fish habitat	May affect but is not likely to adversely affect the northern long-eared bat, tricolored bat, and monarch butterfly; no effect on essential fish habitat; no effect on sanctuary resources of National Marine Sanctuaries
Historic and Cultural Resources	Historic and cultural resources	Would not adversely affect known historic properties
Socioeconomics	Employment and income, recreation, and tourism[a]	SMALL
Socioeconomics	Tax revenues[a]	SMALL
Socioeconomics	Community services and education[a]	SMALL
Socioeconomics	Population and housing[a]	SMALL
Socioeconomics	Transportation[a]	SMALL

Table 3-1 Site-Specific Conclusions Regarding North Anna Subsequent License Renewal (Continued)

Resource Area	Environmental Issue	Impacts
Human Health	Radiation exposures to the public[(a)]	SMALL
Human Health	Radiation exposures to plant workers[(a)]	SMALL
Human Health	Human health impact from chemicals[(a)]	SMALL
Human Health	Microbiological hazards to the public (plants with cooling ponds or canals or cooling towers that discharge to a river)	SMALL
Human Health	Microbiological hazards to plant workers[(a)]	SMALL
Human Health	Chronic effects of electromagnetic fields (EMFs)	Uncertain impact
Human Health	Physical occupational hazards[(a)]	SMALL
Human Health	Electric shock hazards	SMALL
Postulated Accidents	Design-basis accidents[(a)]	SMALL
Postulated Accidents	Severe accidents	See EIS Appendix F
Environmental Justice	Minority and low-income populations	No disproportionate and adverse human health and environmental effects on minority and low-income populations
Waste Management	Low-level waste storage and disposal[(a)]	SMALL
Waste Management	Onsite storage of spent nuclear fuel[(a)]	SMALL
Waste Management	Offsite radiological impacts of spent nuclear fuel and high-level waste disposal[(a)]	[(b)]
Waste Management	Mixed-waste storage and disposal[(a)]	SMALL
Waste Management	Nonradioactive waste storage and disposal[(a)]	SMALL
Cumulative Impacts	Cumulative impacts	See EIS Section 3.15
Uranium Fuel Cycle	Offsite radiological impacts—individual impacts from other than the disposal of spent fuel and high-level waste[(a)]	SMALL
Uranium Fuel Cycle	Offsite radiological impacts—collective impacts from other than the disposal of spent fuel and high-level waste[(a)]	[(c)]
Uranium Fuel Cycle	Nonradiological impacts of the uranium fuel cycle[(a)]	SMALL
Uranium Fuel Cycle	Transportation[(a)]	SMALL
Termination of Plant Operations and Decommissioning	Termination of plant operations and decommissioning	SMALL

Note: gpm = gallons per minute; ROW = right-of-way; SAMA = severe accidents.

(a) Dispositioned as generic (Category 1) for initial license renewal of nuclear power plants in Table B–1 in Appendix B to Subpart A of Title 10 CFR Part 51 (TN250).

(b) The ultimate disposal of spent fuel in a potential future geologic repository is a separate and independent licensing action that is outside the regulatory scope of this site-specific review. Per 10 CFR Part 51 (TN250) Subpart A the Commission concludes that the impacts presented in NUREG-2157 (NRC 2014-TN4117) would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 (TN4878) should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent nuclear fuel and high-level waste disposal, this issue is considered generic to all nuclear power plants and does not warrant a site-specific analysis.

Table 3-1 Site-Specific Conclusions Regarding North Anna Subsequent License Renewal (Continued)

Resource Area	Environmental Issue	Impacts

(c) There are no regulatory limits applicable to collective doses to the general public from fuel cycle facilities. The practice of estimating health effects on the basis of collective doses may not be meaningful. All fuel cycle facilities are designed and operated to meet the applicable regulatory limits and standards. As stated in the 2013 GEIS, "The Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated." (10 CFR Part 54; TN4878) (Section 3.13.3.3 of this EIS).

3.2 Land Use and Visual Resources

This section describes the land use and visual resources in the vicinity of the North Anna site and the potential impacts from the proposed action (SLR) and replacement energy alternatives. Section E3.2 of Dominion's ER (VEPCO 2020-TN8099) describes North Anna's current onsite and offsite land use conditions as well as visual resources.

3.2.1 Land Use

The North Anna site lies on the borders of Louisa and Spotsylvania counties in northeastern Virginia. The site is located within a triangle formed by the cities of Richmond, Charlottesville, and Fredericksburg, Virginia (see Figure 2-1). The sections below describe onsite and offsite land use within a 6-mi (10-km) radius and also describes the Virginia coastal zone, with an emphasis on the statutory and regulatory provisions that govern its use.

3.2.1.1 Onsite Land Use

North Anna Units 1 and 2 are located on a peninsula on the southern shore of Lake Anna, an inland freshwater reservoir created to provide cooling water for the nuclear reactors. Most of the site sits in rural Louisa County, Virginia, with a portion extending into neighboring Spotsylvania County, Virginia. See Figure 3.2-1 in Dominion's ER (VEPCO 2020-TN8099: p. E-3-20), which is incorporated here by reference.

The North Anna site comprises 1,803 ac (730 ha) of which 760 ac (307 ha) are covered by water. Louisa County has zoned the site as I–2, "industrial general zoning district," which allows for utility service. As illustrated in Figure 3.2-1 in Dominion's ER (VEPCO 2020-TN8099: p. E-3-20), deciduous, evergreen, and mixed forest types together covers about 37 percent of the North Anna site. The next largest categories of land cover are open water at 34 percent and developed land at 16 percent of the site. The remaining 13 percent of land cover consists of barren land, shrub/scrub, grassland/herbaceous, pasture/hay, cultivated crops, and wetlands (VEPCO 2020-TN8099).

The Virginia Electric and Power Company (VEPCO) (now Dominion) created Lake Anna in 1972 by damming the North Anna River (VEPCO 2020-TN8384). Outside the North Anna site boundary, the shores of the lake are dotted with homes and communities as the land adjacent to the lake has become increasingly residential. Dominion has granted revocable permits to private landowners to erect docks on the Lake Anna shoreline within North Anna site boundaries. A portion of the WHTF also lies within the North Anna site. Property owners and their guests, although not the general public, have access to lands above the fluctuating water level of the waste heat treatment cooling lagoons. Boaters on Lake Anna have access to some waters within North Anna site boundaries. Dominion has placed floating buoys supporting "No Trespassing" signs on North Anna's Lake Anna security buoy barriers (VEPCO 2020-TN8099).

Boaters on Lake Anna cannot access the waters of the waste heat treatment lagoons, as the two areas are divided by dikes.

In 2003, Dominion requested an ESP for the construction and operation of one or more new nuclear power generating units. The NRC issued a final EIS based on its review of the early site permit in 2006 (NUREG-1811 [NRC 2006-TN8385]) and issued the ESP in 2007 (NRC 2007-TN4). Also in 2007, Dominion submitted a COL request for North Anna Unit 3, a large new LWR that Dominion proposed building on the North Anna site west of and adjacent to Units 1 and 2.

North Anna Unit 3 would have a footprint of 120 ac (49 ha) and use 96 ac (38.8 ha) of land within the North Anna site for construction-related activities. The NRC (TN6) issued a final EIS for the North Anna Unit 3 COL in 2010 and in 2017, (2017-TN8544) granted the COL to Dominion. In its subsequent license renewal ER, Dominion stated that it is no longer pursuing development of, and has made no decision to proceed with, construction of North Anna Unit 3 (VEPCO 2020-TN8099).

3.2.1.2 Coastal Zone

Section 307(c)(3)(A) of the CZMA (16 U.S.C. 1456(c)(3)(A)) (TN1243) requires that applicants for Federal licenses who conduct activities in a coastal zone provide a certification to the licensing agency (here, the NRC) that the proposed activity complies with the enforceable policies of the State's coastal zone program. The Federal Regulations that implement the CZMA indicate that this requirement is applicable to renewal of Federal licenses for actions not previously reviewed by the State (15 CFR 930.51(b)(1); TN4475). North Anna, located in Louisa County, Virginia, does not lie within the Virginia coastal zone designated as Tidewater Virginia (VDEQ 2020-TN8420: Chapter 7.6). However, neighboring Spotsylvania County (and sections of Lake Anna that lie within it), do lie within the Virginia coastal zone. As a result of this proximity, Dominion is required to provide CZMA certification for the proposed action. The Virginia Department of Environmental Quality (VDEQ) is the lead agency for the Virginia Coastal Zone Management Program and is responsible for coordinating the Commonwealth of Virginia's review of Federal consistency determinations and certifications with cooperating agencies and for responding to the appropriate Federal agency or applicant (VDEQ 2021-TN8421).

In a letter dated October 1, 2019, Dominion submitted a CZMA consistency certification package to VDEQ in support of the subsequent renewal of the North Anna operating licenses. On December 23, 2019, VDEQ submitted its completed review and analysis of Dominion's Federal consistency certification package. VDEQ concurred that Dominion's proposal is consistent with the enforceable policies of Virginia's Coastal Zone Management Program, provided all applicable permits and approvals are obtained (VEPCO 2020-TN8099: Attachment E).

3.2.1.3 Offsite Land Use

The 6-mi (10-km) radius of the North Anna site boundary includes portions of Louisa and Spotsylvania counties. Lake Anna is the predominant natural feature. According to Dominion (VEPCO 2020-TN8099), the largest land cover categories in the 6-mi (10-km) radius are forest (48 percent), open water (14 percent), and developed land (7.6 percent).

Louisa County is primarily rural agricultural, with agriculture and forestry as its dominant land uses. The county maintains a rural character by promoting small towns, historical towns, villages, and open spaces (Louisa County 2019-TN8423). In contrast, neighboring Spotsylvania County is one of Virginia's fastest growing counties because of its military bases and proximity to Washington, D.C., and Richmond, Virginia. The highest population densities occur along the Interstate-95 corridor and near Fredericksburg, Virginia, which is approximately 25 mi (40 km) from the site. The primary land use in Spotsylvania County is rural residential (VEPCO 2020-TN8099). Section 15.2-223 of the Code of Virginia requires each county in Virginia to have a comprehensive plan for its physical development. In 2019, Louisa County issued its County of Louisa Comprehensive Plan 2040 (Louisa County 2019-TN8423); Spotsylvania County issued its comprehensive plan in 2013 with updates in 2016 and 2018 (Spotsylvania County 2018-TN8424). In addition, the Lake Anna Special Area Plan issued in 2000 seeks to improve the quality of water in the lake and its tributaries with a coordinated watershed program, maintain the rural character of the lake area by concentrating public service activities and commercial development in village centers, and upgrade transportation around the lake to support the growing population and provide safe evacuation routes (Lake Anna 2000-TN8435).

According to the County of Louisa Comprehensive Plan 2040, "Gold mining took place in Louisa County until the end of the nineteenth century…Other minerals found in the County include silver, copper, lead, mica, sandstone, iron ore, zinc, granite, vermiculite, and quartz. Due to the variety of bedrock types within Louisa County, a host of economic rock and mineral resources are available within the County and continue to be part of the local economy" (Louisa County 2019-TN8423). However, there are currently no mining activities within 10 mi (16 km) of the plant (VEPCO 2020-TN8099). The NRC staff is not aware of any plans to mine or explore for subsurface minerals within 10 mi (16 km) of the North Anna site. Dominion states that there no anticipated plans to explore for subsurface minerals within the plant site boundary (VEPCO 2020-TN8099).

Lake Anna is approximately 17-mi (27-km) long and is divided into two major portions: Lake Anna and the WHTF. The closest publicly accessible property to the North Anna site is Lake Anna State Park, about 5 mi (8 km) northwest of the site. The park is 3,127 ac (1,265 ha) and includes 10 mi (16 km) of shoreline. Park amenities include overnight cabins and camping, a swimming beach, a fishing pond, fishing and boating access, and hiking trails (VDCR 2021-TN8417). Over 400,000 people visited Lake Anna State Park in 2016 (VDCR 2017-TN8418).

3.2.2 Visual Resources

The North Anna site is located at the northern boundary of Louisa County, Virginia, on the south side of Lake Anna. Developed areas of the North Anna site are not generally visible from public roads in Louisa County. According to Dominion (VEPCO 2020-TN8099), nuclear power plant buildings are set back from public roads and hidden from view by heavy forest cover. North Anna buildings are visible when viewed from the north or northeast—for example, by boaters on Lake Anna. However, the buildings are set back from the edge of the lake. The tallest structures are the reactor containment buildings, at approximately 191 ft (58 m). Other prominent structures include the turbine buildings and the transmission lines (VEPCO 2020-TN8099).

3.2.3 Proposed Action

License renewal has had little or no effect on land use on or near the nuclear power plant site. Industrial land use activities at North Anna are not expected to change appreciably until sometime after decommissioning. Similarly, land use activity within transmission line ROWs would continue with no change in land use restrictions, and easements are expected to remain unchanged during the SLR term. The following sections address the site-specific environmental impacts of North Anna SLR on the environmental issues related to land use and one visual resource issue.

3.2.3.1 Onsite Land Use

Operational activities during the SLR term would be similar to those already occurring at North Anna. The industrial nature of onsite land use would continue unchanged. However, land may be needed in the future for the onsite storage of the spent nuclear fuel and low-level radioactive waste generated during the SLR term. The location and the amount of land affected cannot be predicted at this time.

Based on this information, the NRC staff concludes that the impact of continued nuclear power plant operations on onsite land use during the North Anna SLR term would be SMALL. In addition, the NRC staff did not identify any new onsite land use information that would alter this conclusion.

3.2.3.2 Offsite Land Use

License renewal activities have had little to no effect on population or tax revenue in communities near nuclear power plants. Employment levels at North Anna have remained the same or have slightly decreased with no increased demand for housing, infrastructure improvements, or services. Operational activities during the SLR term would be similar to those already occurring at North Anna and would not affect offsite land use beyond what has already been affected.

Based on this information, the NRC staff concludes that the impact of continued nuclear power plant operations on offsite land use during the North Anna SLR term would be SMALL. In addition, the NRC staff did not identify any new offsite land use information that would alter this conclusion.

3.2.3.3 Offsite Land Use in Transmission Line Rights-of-Way

Maintenance activities in transmission line ROWs during the license renewal term would be the same as or similar to those already occurring and would not affect offsite land use beyond what has already been affected. Transmission line ROWs do not preclude the use of the land for other purposes, such as agriculture and recreation. However, land use is limited to activities that do not endanger power line operation.

Based on this information, the impact of continued nuclear power plant operations during the North Anna SLR term on offsite land use in transmission line ROWs would be SMALL. In addition, the NRC staff did not identify any new land use information that would alter this conclusion.

3.2.3.4 Aesthetic Impacts

The visual appearance of North Anna and associated transmission lines have become well established during the current licensing term and are not likely to change appreciably over time. As a result, the NRC staff concludes that the visual impact of continued nuclear power plant operations at North Anna during the SLR term would be SMALL, because the visual appearance of the nuclear power plant and transmission lines would not change. In addition, the NRC staff did not identify any new information that would alter this conclusion.

3.2.4 No-Action Alternative

3.2.4.1 Land Use

Under the no-action alternative, the NRC would not renew the North Anna operating licenses, and reactor operations would cease on or before the expiration of the current renewed licenses in 2038 and 2040. Under this alternative, land uses would remain similar to those that would occur under the proposed SLR. Shutdown of North Anna would not affect onsite land use. Plant structures and other facilities would remain in place until decommissioning. Most transmission lines would remain in service after the cessation of reactor operations. Maintenance of most existing nuclear plant infrastructure would continue. Based on this information, land use impacts under the no-action alternative would be SMALL.

3.2.4.2 Visual Resources

Termination of reactor operations because of not renewing the operating licenses under the no-action alternative would not change the visual appearance of the North Anna site. The most visible structures are the containment buildings, and they would likely remain in place for some time during decommissioning until they are eventually dismantled. Overall, visual impacts from the no-action alternative would be SMALL.

3.2.5 Replacement Power Alternatives: Common Impacts

3.2.5.1 Land Use

Land use impacts are determined by the change in use and the amount of land affected by the construction and operation of a replacement power generating facility, infrastructure, and other installations.

<u>Construction</u>

Construction of a replacement power generating facility would require the permanent commitment of land designated for industrial use. Existing transmission lines and infrastructure would adequately support each of the replacement energy alternatives, thus reducing the need for additional land commitments.

<u>Operations</u>

Operation of new power generating facilities would have no land use impacts beyond land committed for the permanent use of the replacement power plant. Additional land may be required to support power plant operations, including land for mining, extraction, and waste disposal activities associated with each alternative.

3.2.5.2 Visual Resources

Visual impacts are determined by the degree of contrast between the replacement power generating facility and the surrounding landscape and the visibility of the new power plant.

<u>Construction</u>

Land for any replacement energy generating facility would require clearing, excavation, and the use of construction equipment. Temporary visual impacts may occur during construction from cranes and other construction equipment.

<u>Operations</u>

Visual impacts during power plant operations of any of the replacement energy alternatives would be similar in type and magnitude. New cooling towers (if built) and their associated vapor plumes would be the most obvious visual impact and would likely be visible farther from the site than other buildings and infrastructure. New power plant stacks or towers may require aircraft warning lights, which would be visible at night.

3.2.6 New Nuclear (Small Modular Reactor) Alternative

3.2.6.1 Land Use

Construction

Approximately 200 ac (81 ha) of land west and adjacent to North Anna Units 1 and 2 are available for siting five SMRs. This land was previously considered for the construction of North Anna Unit 3 (NRC 2006-TN8385). Small wetland areas and two intermittent streams would be affected. Dominion indicated any work with the potential to impact a wetland would be performed in accordance with regulatory requirements. The five SMRs would use existing North Anna infrastructure and transmission lines. The land is already zoned for industrial use and the site has been used to generate electricity. Based on this information, land use impacts from the construction of a new nuclear alternative would be SMALL.

Operations

Land would be needed elsewhere for uranium mining and fuel fabrication to support up to 40 years of nuclear power plant operations. Land use impacts would be similar to those experienced during North Anna operation. Based on this information, land use impacts from operating a new nuclear power plant could range from SMALL to MODERATE, depending on how much additional land may be needed for uranium mining and fuel fabrication.

3.2.6.2 Visual Resources

Construction and Operations

Visual impacts from a new nuclear alternative would be similar to the common impacts of all replacement power alternatives described in Section 3.2.5.2, “Visual Resources.” Construction activities and equipment such as cranes could be visible from Lake Anna, but these would be temporary and in character for an industrial site (VEPCO 2020-TN8099). During operations, the visual appearance of the five SMR power block would be similar to the industrial appearance of the North Anna Unit 1 and 2 power blocks. The new nuclear alternative also would require the construction of 65-ft (20-m) mechanical draft cooling towers, which could increase the visual impact by producing water vapor plumes visible from great distances. Therefore, visual impacts during the construction and operation of a new SMR power plant at the North Anna site, including cooling tower plumes that could be visible from great distances, could range from SMALL to MODERATE, depending on seasonal weather conditions.

3.2.7 Combination Alternative (Solar, Offshore Wind, Small Modular Reactor, and Demand-Side Management)

3.2.7.1 Land Use

Construction and Operation

The solar photovoltaic portion of the combination alternative would require eight utility-scale solar photovoltaic power plants with a total area of approximately 20,000 ac (8,000 ha) of land, with additional land required for construction staging and laydown. Each photovoltaic power plant would be located in the North Anna ROI and with access to Dominion transmission systems. Land use impacts would depend largely on the land acquired for the solar photovoltaic plant. For example, installing the solar photovoltaic plant on land designated for industrial use would have less of an impact than if land had to be changed from other uses (e.g., converting residential or prime farmland to industrial use) or if located adjacent to or near residential or recreational land use areas. Adding to the land use impact is the fact that standalone solar photovoltaic facilities cannot be co-located with other land uses (e.g., grazing and crop-producing agriculture). Based on this information, land use impacts during construction and operation of the solar photovoltaic plants could range from MODERATE to LARGE, depending on the type and location of land chosen for the eight installations.

Although most construction and operation activities for the wind farms would occur offshore, onshore land use would also be affected during construction. Land would be needed for onshore support facilities. Coastal area economies are dependent on tourism and recreation. Construction of wind facilities can disturb beaches, dunes, coastal wetlands, and bays during the installation of onshore components, such as interconnection cables, fiber optic cables, switch cabinets, and interconnection stations (BOEM 2015-TN8399).

Virginia's Coastal Zone Management Program prohibits locating onshore facilities near sensitive coastal resources to mitigate land use impacts during construction. For the pilot portion of the Coastal Virginia Offshore Wind project, Dominion limited onshore construction activities to previously disturbed areas such as parking lots, roadways, and ROWs to minimize disruption to sensitive shoreline (BOEM 2015-TN8399). In compliance with Virginia Coastal Zone Management Program, Dominion would limit onshore construction to previously disturbed areas and has proposed that power cables make landfall at the State Military Reservation in Virginia Beach (Camp Pendleton), and avoid impacts on shore communities dependent on tourism (VEPCO 2021-TN8441). Because onshore construction would occur on previously disturbed areas on the State Military Reservation, land use impacts from the construction and operation of an offshore wind facility would be SMALL to MODERATE.

Land use impacts for the SMR would be similar and less than the impacts described in Section 3.2.6.1 for the new nuclear alternative. The single SMR would require 36 ac (14 ha) of land. Land use impacts associated with uranium mining and fuel fabrication for one SMR would be less than the amount of land needed to support North Anna operations. Based on this information, land use impacts from the construction and operation of one SMR at North Anna would be SMALL, as the land is already zoned for industrial use.

Land use impacts associated with demand-side management would be limited to manufacture of energy efficient equipment and insulating materials and land used for the disposal of inefficient appliances and material at existing recycling and disposal facilities. Overall land use impacts from the construction and operation of the combination alternative range from SMALL to LARGE, due to the large amount of land and land uses affected by the solar installations.

3.2.7.2 Visual Resources

<u>Construction and Operations</u>

Utility-scale solar photovoltaic installations require large land areas, and solar panels could be visible to the public from offsite locations, depending on buffer areas or screening. Solar photovoltaic installations would be sited to comply with land use zoning and any required buffers or screening.

Wind turbines would be visible from all directions and could have a large impact on the viewshed depending on the location of the wind farm site. Avoiding impacts on the most scenic viewsheds would reduce the most significant visual impacts, allowing the impact to be noticeable but not destabilizing. When visible, offshore wind turbines can have a negative impact on tourism and shoreline property values. Dominion states it will place the turbines 27 mi (43 km) from shore (VEPCO 2021-TN8441). Depending on placement, some turbines could be visible from shore.

Visual impacts from constructing and operating one SMR would be similar and less than the impacts described in Section 3.2.6.2, "Visual Resources," for the new nuclear alternative. Construction activities could be visible from Lake Anna (VEPCO 2020-TN8099).

Demand-side management is not likely to have any visual impact. Overall, the visual impacts from the construction and operation of the combination alternative could range from SMALL to LARGE. This range is primarily due to the potential visual impacts from the solar and wind components of this alternative.

3.3 Meteorology, Air Quality, and Noise

This section describes the meteorology, air quality, and noise environment in the vicinity of North Anna. The description of the resources is followed by the staff's analysis of the potential air quality and noise impacts from the proposed action (i.e., SLR) and alternatives to the proposed action.

3.3.1 Meteorology and Climatology

Virginia has a generally humid climate characterized by very warm summers and moderately cold winters. However, substantial regional variations in temperature and precipitation patterns occur due to the State's diverse geographic features. Specifically, the influence of the Appalachian Mountains and Blue Ridge Mountains result in the western and northern portions of the State being relatively cooler and drier. In east-central Virginia, the mountains act as a barrier to outbreaks of cold, continental air in winter (NOAA 2020-TN8533). The Chesapeake Bay and Atlantic Ocean contribute to humid summers and mild winters. Precipitation is uniformly distributed throughout the year, but there is variability in total monthly amounts from year to year.

The NRC staff obtained climatological data from the Richmond International Airport weather station (Richmond weather station). This station is approximately 55 mi (88 km) from the North Anna site, and the NRC staff used this weather station to characterize the region's climate because of its relatively nearby location and long period of record. Dominion also maintains a meteorological monitoring system comprised of a primary and a backup meteorological tower (VEPCO 2020-TN8099). The primary meteorological tower is located east of Units 1 and 2 and measures wind speed, wind direction, horizontal wind direction fluctuation, ambient temperature, differential temperature, dew point, and precipitation. The backup tower is located approximately 1,300 ft (396 m) northeast of the Unit 1 reactor and measures wind speed, wind direction, ambient temperature, and horizontal wind direction. In its ER, Dominion provided meteorological observations from the North Anna site (VEPCO 2020-TN8099) for the 1988–2017 period. The staff evaluated these data in context with the climatological record from the Richmond International Airport weather station.

The mean annual temperature for the 102-year period of record (1920–2022) at the Richmond weather station is 58.5°F (14.7°C), with the mean monthly temperature ranging from a low of

38.0°F (3.3°C) in January and a high of 78.6°F (25.8°C) in July (NOAA 2023-TN9551, NOAA 2023-TN8989). The mean annual temperature from the North Anna onsite meteorological tower is 57.2°F (14.0°C), with a mean monthly temperature ranging from a low of 36.2°F (2.3°C) in January to a high of 77.1°F (25.1°C) in July (VEPCO 2020-TN8099).

The average annual total precipitation for the 102-year period of record (1920–2022) at the Richmond weather station is 43.7 inches (in.) (111 centimeters [cm]), with mean monthly precipitation ranging from a low of 2.88 in. (7.3 cm) in February, to a high of 4.94 in. (12.6 cm) in July (NOAA 2023-TN9477). The mean total annual precipitation from the North Anna onsite meteorological tower is 31 in. (78.7 cm), with a mean monthly precipitation ranging from a low of 1.79 in. (4.5 cm) in February, to a high of 3.55 in. (9.0 cm) in August (VEPCO 2020-TN8099).

The mean annual wind speed during a 39-year period of record at the Richmond weather station is 7.6 miles per hour (mph) (3.4 m/second [m/s]), with prevailing winds being from the south-southwest (NOAA 2023-TN8989). The mean annual wind speed from the North Anna onsite meteorological tower is 5.4 mph (2.4 m/s), with prevailing wind direction from the south-southwest (VEPCO 2020-TN8099).

Virginia is subject to occasional extreme weather events, including severe thunderstorms, tornadoes, winter storms, tropical storms, hurricanes, droughts, and heat waves (Runkle et al. 2017-TN8445; NOAA 2013-TN7424). The following severe weather events have been reported in Louisa County from January 1950 to March 2023 (NOAA 2023-TN8432):

- tornadoes: 15 events
- floods: 8 events
- heavy rain falls: 65 events
- thunderstorms: 197 events

3.3.2 Air Quality

Under the Clean Air Act (CAA) of 1963, as amended, 42 U.S.C 7401, et seq. (Clean Air Act-TN1141), the EPA has set primary and secondary National Ambient Air Quality Standards (NAAQS), 40 CFR Part 50 (TN1089), “National Primary and Secondary Ambient Air Quality Standards” for six common criteria pollutants to protect sensitive populations and the environment. The NAAQS criteria pollutants include carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), and particulate matter (PM). PM is further categorized by size—PM_{10} (diameter between 2.5 and 10 micrometers [μm]) and $PM_{2.5}$ (diameter of 2.5 μm or less).

The EPA designates areas of attainment and nonattainment with respect to meeting NAAQS. Areas for which there are insufficient data to determine attainment or nonattainment are designated as unclassifiable. Areas that were once in nonattainment, but now are in attainment, are called maintenance areas; these areas are under a 10-year monitoring plan to maintain the attainment designation status. States have primary responsibility for ensuring attainment and maintenance of the NAAQS. Under Section 110 of the CAA (42 U.S.C. 7410; TN4851) and related provisions, States are to submit, for the EPA approval, State implementation plans that provide for the timely attainment and maintenance of the NAAQS.

In Virginia, air quality designations are made at the county level. For the purpose of planning and maintaining ambient air quality with respect to the NAAQS, the EPA has developed air quality control regions. Air quality control regions are intrastate or interstate areas that share a common airshed. North Anna is located primarily in Louisa County, Virginia, with a portion of the site extending into neighboring Spotsylvania County, Virginia. Louisa County and Spotsylvania County are within the Northeastern Virginia Intrastate Air Quality Control Region (40 CFR 81.144; TN7226). With regards to NAAQS, the EPA designates Louisa County in attainment for all criteria pollutants (40 CFR 81.347; TN7226). Spotsylvania County is designated as a maintenance area for ozone (8-hr 1997 standard) (EPA 2023-TN8419).

3.3.3 Noise

Noise can be unwanted sound and can be generated by many sources. Sound intensity is measured in logarithmic units called decibels (dB). A dB is the ratio of the measured sound pressure level to a reference level equal to a normal person's threshold of hearing. Most people barely notice a difference of 3 dB or less. Another characteristic of sound is frequency or pitch. Noise may be composed of many frequencies, but the human ear does not hear very low or very high frequencies. To represent noise as closely as possible to the noise levels people experience, sounds are measured using a frequency-weighting scheme known as the A-scale. Sound levels measured on this A-scale are given in units of A-weighted decibels (dBA). Levels can become annoying at 80 dBA and very annoying at 90 dBA. To the human ear, each increase of 10 dBA sounds twice as loud (EPA 1981-TN7412).

Several different terms are commonly used to describe sounds that vary in intensity over time. The equivalent sound intensity level represents the average intensity level over a specified interval, often 1 hour. The day-night sound intensity level is a single value calculated from hourly intensity level over a 24-hour period, with the addition of 10 dBA to sound levels from 10 p.m. to 7 a.m. This addition accounts for the greater sensitivity of most people to nighttime noise. Statistical sound level (Ln) is the sound level that is exceeded "n" percent of the time during a given period. For example, L90, is the sound level exceeded 90 percent of time and is considered the background level.

As discussed in Section 3.2.1.1, North Anna is designated as an industrial district, and the vicinity of the site is designated as industrial, agricultural, commercial, or residential. Louisa County has a noise ordinance that limits sound levels to 75 dB and nighttime sound levels to 65 dB, measured at the property boundary, for industrial zoning districts. Primary offsite noise sources in the vicinity of North Anna include boats and recreational activities on Lake Anna and vehicular traffic. The nearest resident is located approximately 0.9 mi (1.4 km) north northeast from North Anna (VEPCO 2020-TN8099). Primary noise sources at North Anna include turbine generators, transformers, loudspeakers, transmission lines, firing range, emergency diesel generators, and main steam safety valves. Between 2013 and 2022, North Anna received one noise complaint due to a 24-hour emergency diesel generator test run during an outage (VEPCO 2020-TN8099, VEPCO 2021-TN8179, VEPCO 2023-TN8534).

3.3.4 Proposed Action

The following sections address the site-specific environmental impacts of North Anna SLR on the environmental issues identified in Table 3-1 that relate to air quality and noise.

3.3.4.1 Air Quality Impacts (All Plants)

The ambient air quality in the vicinity of North Anna is describe in Section 3.3.2. Impacts on air quality during normal plant operations can result from operations of fossil-fuel-fired equipment needed for various plant functions. The VDEQ regulates air emissions at North Anna under a

State Operating Permit (Air Permit No. 40726). Impacts on air quality during normal plant operations can result from operations of diesel generators at North Anna. Table 3-2 lists permitted air pollutant emission sources and air permit-specific conditions. In 2019, the North Anna State Operating Permit was amended to remove two auxiliary boilers, and therefore cease operations of these two boilers (VEPCO 2021-TN8268). Dominion submits annual emission reports to VDEQ in accordance with the State Operating Permit. Dominion reports that it has not received any notices of violation between 2013 and 2022 (VEPCO 2020-TN8099, VEPCO 2023-TN8534). The NRC staff's review of the EPA 's Enforcement and Compliance History Online system 3-year compliance history (July 2020 through June 2023), revealed no notices of violation and no permit exceedances (EPA 2023-TN8422).

Table 3-2 Permitted Air Emissions Sources at North Anna Power Station

Equipment	Air Permit Condition
One (1) blackout diesel generator	PM_{10}: 1.8 pounds (lb)/hour, 1.0 ton/year SO_2: 18.5 lb/hour, 4.6 tons/year NO_2: 157.2 lb/hour, 39.3 tons/year CO: 29.9 lb/hour, 10.4 tons/year VOC 6.7 lb/hour, 1.7 tons/year Opacity: <20% except for one 6-minute period of not more than 30% opacity
Four (4) emergency diesel generators	NO_2: 112.4 lb/hour/engine, 3.2 lb/MMBtu/engine, 56.2 tons/year

Note: CO = carbon monoxide; lb = pound; lb/MMBtu = pounds per million British thermal unit; NO_2 = nitrogen dioxide; PM_{10} = particulate matter less than 10 microns, SO_2 = sulfur dioxide, VOC = volatile organic compounds.
Source: VEPCO 2021-TN8268.

In addition to the air-permitted sources listed in Table 3-2, North Anna has one emergency generator, one diesel generator, and two fire pump diesel generators that are exempt from air-permitting conditions (unpermitted sources). These air emission sources are listed in the State Operating Permit and are considered insignificant equipment emission units of minimal or no air quality concern, in accordance with VAC 5-80-720 (VEPCO 2021-TN8268).

Table 3-3 shows annual emissions from the four emergency diesel generators and the blackout diesel generator at North Anna. Table 3-4 presents annual air emissions for Louisa and Spotsylvania County. The contribution of air emissions from sources at North Anna constitutes less than 1 percent of annual emissions from either Louisa County or Spotsylvania County. Dominion does not anticipate refurbishment activities during the proposed SLR term (VEPCO 2023-TN8534). As a result, the NRC staff expects that air emissions from the plant during the SLR term would be similar to those presented in Table 3-2.

The EPA promulgated the Regional Haze Rule to improve and protect visibility in national parks and wilderness areas from haze, which is caused by numerous, diverse air pollutant sources located across a broad region (40 CFR 51.308–309; TN1090). Specifically, 40 CFR Part 81 (TN7226), Subpart D, "Identification of Mandatory Class I Federal Areas Where Visibility Is an Important Value," lists mandatory Federal areas where visibility is an important value. The Regional Haze Rule requires States to develop State Implementation Plans to reduce visibility impairment at Class I Federal Areas. There are two Class 1 Federal Areas in Virginia: (1) Shenandoah National Park and (2) James River Face Wilderness, approximately 60 mi (96 km) and 75 mi (121 km), respectively, from North Anna. Federal land management agencies that administer Federal Class I areas consider an air pollutant source that is located greater than 31 mi (50 km) from a Class I area to have negligible impacts with respect to Class I areas if the total SO_2, NO, PM_{10}, and sulfuric acid annual emissions from the source are less than 500 tons per year (70 FR 39104-TN8374; NPS 2010-TN7925). Given the distance of North Anna to Class I areas and the air emissions presented, there is little likelihood that ongoing activities at North Anna adversely affect air quality in any such designated area.

Table 3-3 Reported Air Pollutant Emissions from North Anna Power Station (tons/year)

Year	SO_2	NOx	CO	PM_{10}	VOCs
2018	0.05	10.6	2.6	0.17	0.32
2019	0.04	9.5	2.4	0.16	0.28
2020	0.04	8.4	2.0	0.13	0.26
2021	0.04	8.4	2.0	0.14	0.25
2022	0.04	9.3	2.3	0.15	0.27

Note: CO = carbon monoxide; NOx = nitrogen oxides; PM_{10} = particulate matter less than 10 micrometers; SO_2 = sulfur dioxide; VOCs = volatile organic compounds.
To convert tons per year to metric tons per year, multiply by 0.90718.
Source for North Anna air emissions: VEPCO 2023-TN8534.

Table 3-4 Annual Air Emission for Louisa and Spotsylvania County (tons/year)

County	SO_2	NOx	CO	PM_{10}	VOC
Louisa County	38	1,301	10,452	1,544	n/a
Spotsylvania County	53	2,256	18,099	1,238	n/a

Note: CO = carbon monoxide; n/a = not applicable; NO_x = nitrogen oxides; PM_{10} = particulate matter less than 10 micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compounds.
To convert tons per year to metric tons per year, multiply by 0.90718.
Source: EPA 2022-TN8463.

Dominion does not anticipate future upgrades or replacements of air emissions sources (e.g., diesel generators) during the SLR term to support plant operations (VEPCO 2023-TN8534). SLR would continue current operating conditions; therefore, the impacts of current operations and SLR would be similar. Given North Anna's limited air emissions as presented in Table 3-2, there is little likelihood that ongoing activities at North Anna during the SLR term would adversely affect air quality and air quality-related values. Based on these considerations, the NRC staff concludes that the air quality impacts of continued nuclear plant operations at North Anna during the SLR term would be SMALL.

3.3.4.2 Air Quality Effects of Transmission Lines

Small amounts of ozone and substantially smaller amounts of oxides of nitrogen are produced during corona, a phenomenon that occurs when air ionizes near isolated irregularities on the conductor surface of transmission lines. Dominion has not conducted field tests of ozone and nitrogen oxide emissions generated by North Anna's 34.5 kV and 500 kV transmission lines (VEPCO 2023-TN8534). Several studies have quantified the amount of ozone generated and concluded that the amount produced by even the largest lines in operation (765 kilovolt [kV]) is insignificant (SNYPSC 1978-TN7478; Scott-Walton et al. 1979-TN7480; Janes 1978-TN7479; Varfalvy et al. 1985-TN7364). Monitoring of ozone levels for 2 years near a Bonneville Power Administration 1,200 kV prototype line revealed no increase in ambient ozone levels caused by the line (Lee et al. 1989-TN7481). Similarly, field tests conducted over a 19-month period concerning ozone levels adjacent to Sequoyah Nuclear Plant transmission lines concluded that high-voltage lines up to 765 kV do not generate ozone above ambient measurements made at locations remote from transmission lines (TVA 2013-TN7899; NRC 2015-TN5842). The ozone concentrations generated by transmission lines are therefore too low to cause any significant effects. The minute amounts of oxides of nitrogen produced are similarly insignificant. SLR would continue current operating conditions. On the basis of these considerations, the NRC concludes that the air quality impacts of transmission lines, during the SLR term would be SMALL.

3.3.4.3 Noise Impacts

The ambient noise conditions in the vicinity of North Anna are described in Section 3.3.3. Dominion does not anticipate refurbishment activities during the proposed SLR term, and nuclear plant operations would not change appreciably with time. Therefore, there would be no noise generated by construction-related activities and equipment used during refurbishment. The primary noise sources and noise levels currently present at North Anna, as discussed in Section 3.3.3, would be the same during the SLR term. Noise from many of the sources at North Anna (e.g., firing range, emergency diesel generators, transmission lines, and main steam safety valves) is intermittent. Noise from the turbine generator is continuous, but accounting for the building walls as a noise barrier noise and dissipation given the distance to nearby residents (0.9 mi (1.4 km)), noise levels are not expected to be distinguishable from other noise in the vicinity of North Anna. As discussed in Section 3.3.3, if planned potential noise-generating activities are scheduled, Dominion may make a public announcement to local media to inform the public of the activity (VEPCO 2020-TN8383, VEPCO 2022-TN8270). Furthermore, Louisa County has a noise ordinance that limits daytime sound levels to 75 dB and nighttime sound levels to 65 dB, measured at the property boundary, for industrial zoning districts to prevent excessive noise levels.

Given that no change is expected in the noise sources and levels during the SLR term, an established noise ordinance, distance to nearest residents, the NRC concludes that noise impacts from continued operations of North Anna during the SLR term would be SMALL.

3.3.5 No-Action Alternative

3.3.5.1 Air Quality

Under the no-action alternative, the cessation of North Anna operations would reduce overall air pollutant emissions (e.g., from diesel generators, engines, and vehicular traffic). Therefore, the NRC staff concludes that, if emissions decrease, the impact on air quality from the direct shutdown of North Anna would be SMALL.

3.3.5.2 Noise

The termination of reactor operations would result in a reduction in noise from activities related to nuclear power plant operation, including noise from the turbine generators, transformers, firing range, main steam safety valves, and vehicular traffic (e.g., workers, deliveries). As site activities are reduced, the NRC staff expects the impact on ambient noise levels to be less than current plant operations; therefore, the NRC staff concludes that impacts on noise levels from the no-action alternative would be SMALL.

3.3.6 Replacement Power Alternatives: Common Impacts

3.3.6.1 Air Quality

<u>Construction</u>

Construction of a power station under a replacement power alternative would result in temporary impacts on local air quality. Air emissions include criteria pollutants (particulate matter, nitrogen oxides, carbon monoxide, and sulfur dioxide), VOCs, hazardous air pollutants, and GHGs. Air emissions would be intermittent and would vary, based on the level and duration of specific activities throughout the construction phase. During the construction phase, the primary sources of air emissions would consist of engine exhaust and fugitive dust emissions. Engine exhaust emissions would be from heavy construction equipment and commuter, delivery, and support vehicular traffic traveling to and from the facility as well as within the site. Fugitive dust emissions would be from soil disturbances by heavy construction equipment (e.g., earthmoving, excavating, and bulldozing), vehicular traffic on unpaved surfaces, concrete batch plant operations, and wind erosion to a lesser extent.

Various mitigation techniques and best management practices (BMPs) (e.g., watering disturbed areas, reducing equipment idle times, and using ultralow sulfur diesel fuel) could be used to minimize air emissions and to reduce fugitive dust.

<u>Operations</u>

The impacts on air quality as a result of operation of a power station for a replacement power alternative would depend on the energy technology (e.g., nuclear or renewable). Worker vehicles, auxiliary power equipment, and mechanical draft cooling tower operation will also result in additional air emissions.

3.3.6.2 Noise

<u>Construction</u>

Construction of a replacement power facility would be similar to the construction of any industrial facility, in that all involve many noise-generating activities. In general, noise emissions would vary during each phase of construction, depending on the level of human activity, types of equipment and machinery used, and site-specific conditions. Typical construction equipment, such as dump trucks, loaders, bulldozers, graders, scrapers, air compressors, generators, and mobile cranes, would be used, and pile-driving and blasting activities could take place. Other noise sources include construction worker vehicular and truck delivery traffic. However, noise from vehicular traffic would be intermittent.

<u>Operations</u>

Noise generated during operations could come from mechanical draft cooling towers, transformers, turbines, machinery, equipment, and communication announcements and sirens, as well as offsite sources, such as employee and delivery vehicular traffic. Noise from vehicles would be intermittent and at levels similar to noise levels currently generated at North Anna.

Similarly, with the exception of the additional noise from mechanical draft cooling towers, operational noise levels at a replacement nuclear power plant, excluding solar photovoltaic and offshore wind facilities, would likely be similar to existing noise levels at North Anna.

3.3.7 New Nuclear (Small Modular Reactor) Alternative

3.3.7.1 Air Quality

<u>Construction</u>

Air emissions and sources associated with construction of the new nuclear alternative would include those identified as common to all replacement power alternatives in Section 3.3.6.1. Because air emissions from construction activities would be limited, local, and temporary, the NRC staff concludes that the associated air quality impacts from construction of a new nuclear alternative would be SMALL.

<u>Operations</u>

Operation of the new nuclear alternative would result in air emissions similar in magnitude to air emissions from the operation of North Anna. Sources of air emissions would include stationary combustion sources (e.g., diesel generators, auxiliary boilers, and gas turbines) and mobile sources (e.g., worker vehicles, onsite heavy equipment, and support vehicles). Additional air emissions would result from the new nuclear power plant's use of mechanical draft cooling towers (rather than the once-through cooling system currently used by North Anna) and could contribute to impacts associated with the formation of visible plumes, fogging, and subsequent icing downwind of the towers.

In general, most stationary combustion sources at a nuclear power plant would operate only for limited periods, often during periodic maintenance testing. A new nuclear power plant would need to secure a permit from VDEQ for air pollutants associated with its operations (e.g., criteria pollutants, VOCs, hazardous air pollutants, and GHGs). The NRC staff expects the air emissions for combustion sources from a new nuclear power plant to be similar to those currently being emitted from North Anna (see Section 3.3.6.1). Therefore, the NRC staff expects that the combined air quality impact of emissions from onsite sources would be minor.

Additional air emissions would result from the approximately 1,200 employees commuting to and from the new nuclear facility. Given that the NRC estimates that air emissions would be minor and given the attainment status of Louisa County and Spotsylvania County, the NRC staff does not expect air emissions from operation of a new nuclear alternative to contribute to NAAQS violations. The NRC staff concludes that the impacts of operation of a new nuclear alternative on air quality would be SMALL.

3.3.7.2 Noise

<u>Construction</u>

Noise generated during the construction and operation of a new nuclear power plant would be similar to noise for all replacement power alternatives, as discussed in Section 3.3.6.2. Noise impacts during construction would be limited to the immediate vicinity of the North Anna site. Based on the temporary nature of construction activities, the distance of noise-sensitive receptors from the site, consideration of noise attenuation from the construction site, and good noise control practices, the NRC staff concludes that the potential noise impacts of construction activities from a new nuclear alternative would be SMALL.

Operations

Sources of noise during nuclear power plant operations would include industrial equipment, machinery, vehicles, and communications. Noise levels from these sources would be similar to or less than noise levels generated during the operation of North Anna. Mechanical draft cooling towers generate noise during operations. However, given the distance of nearby noise-sensitive receptors from the North Anna site (0.9 mi [1.4 km]), the NRC staff does not expect offsite noise levels from mechanical draft cooling towers to nearby receptors to be greater than current levels. Therefore, noise impacts during SMR operations would be SMALL.

3.3.8 Combination Alternative (Solar, Offshore Wind, Small Modular Reactor, and Demand-Side Management)

3.3.8.1 Air Quality

Construction

Air emissions and sources for construction of the new nuclear and solar portions of this combination alternative would include those identified as common to all replacement power alternatives in Section 3.3.6.1. Air emissions from construction would be localized and intermittent, and well-understood construction BMPs would mitigate air quality impacts. Therefore, the NRC staff concludes that the air quality impacts associated with construction of the new nuclear and solar portions of the combination alternative would be SMALL. No air emissions would result from demand-side management initiatives. Air emissions and sources for construction of the offshore wind component would be as a result of engine exhaust of heavy equipment and vessel traffic associated with installation of the meteorological data collection facilities (meteorological towers or meteorological buoys) and wind turbines. However, given the distance to shore and prevailing westerly winds, the NRC does not anticipate engine exhaust emissions to impact onshore air quality (BOEM 2021-TN8356). Because vessel traffic traveling to and from offshore sites would be intermittent, and activity onshore would be of short duration, air emissions would be negligible, and the NRC does not anticipate traffic to affect onshore air quality. Therefore, the NRC staff concludes that the air quality impacts associated with construction of the offshore wind component of the combination alternative would be SMALL.

The NRC staff concludes that the overall air quality impacts from construction of the combination alternative would be SMALL.

Operations

Air emissions associated with operation of the new nuclear component would be similar to, but less than, those associated with the new nuclear alternative discussed in Section 3.3.7.1. Air emissions associated with operation of the offshore wind component would be associated with diesel generators supporting meteorological data collection facilities (meteorological towers or meteorological buoys) and engine exhaust of vessel traffic traveling to and from offshore sites for operation and maintenance activities (BOEM 2021-TN8356). However, given the distance to shore and prevailing westerly winds (BOEM 2021-TN8356), the use of diesel generators would not impact onshore air quality. Because vessel traffic traveling to and from offshore sites would be intermittent and activity onshore would be of short duration, air emissions would be negligible, and the NRC does not anticipate traffic to affect onshore air quality. Therefore, the NRC staff concludes that the air quality impacts associated with operation of the offshore wind component of the combination alternative would be SMALL.

Air emissions associated with the operation of the solar portion are negligible because no fossil fuels are burned to generate electricity. Emissions from solar fields would include fugitive dust and engine exhaust emissions from vehicles and heavy equipment associated with site inspections, maintenance activities (panel washing or replacement), and wind erosion from cleared lands and access roads. The types of emission sources and pollutants during operation would be similar to those during construction, but noticeably fewer emissions would be released during operation. Therefore, the NRC staff concludes that the air quality impacts associated with operation of the solar portion of the combination alternative would be SMALL. No air emissions would result from demand-side management initiatives. The NRC staff concludes that the overall air quality impacts from operations of the combination alternative would be SMALL.

3.3.8.2 Noise

Construction

Construction-related noise sources for the new nuclear alternative would be similar to the new nuclear alternative discussed in Section 3.3.7.2 of this EIS. Therefore, the NRC staff concludes that the noise impacts associated with construction of the new nuclear portion of the combination alternative would be SMALL. Depending on the site locations of the solar portion of the combination and distance of nearby noise-sensitive receptors, construction noise can be noticeable. Therefore, noise impacts associated with construction of the solar portion of the combination alternative would be SMALL to MODERATE. Noise impacts would not result from demand-side management initiatives.

Construction-related noise sources associated with the offshore wind component would include boring, drilling, dredging, pile driving, and heavy equipment and vessel traffic. Given the distance from shore (30 mi [48 km]) where the construction activities would occur, noise generated during these activities would not be audible on shore. Therefore, the NRC staff concludes that noise impacts associated with construction of the offshore wind component portion of the combination alternative would be SMALL. The NRC staff concludes that the overall noise impacts associated with construction of the combination alternative would be SMALL to MODERATE.

Operations

Noise impacts associated with the new nuclear portion of the combination alternative would be similar to those described for the new nuclear alternative in Section 3.3.7. Therefore, the NRC staff concludes that operation-related noise impacts from the new nuclear portion of the combination alternative would be SMALL.

Because the solar photovoltaic portion of the combination alternative would have no power block or cooling towers, a minimal number of noise sources, such as transformers and vehicular traffic, would be associated with maintenance and inspection activities. Therefore, the NRC staff concludes that operations-related noise impacts from the solar photovoltaic portion of the combination alternative would be SMALL.

Given the distance from shore (30 mi [48 km]), wind turbine noise would not be audible on shore. Vessel-traffic-related noise would be intermittent and decrease as distance increases from shore. Navigation of vessels in the vicinity of the turbines would be short term and intermittent, resulting in minor noise impacts to noise-sensitive receptors. Therefore, the NRC staff concludes that operations-related noise impacts from the offshore wind component portion of the combination alternative would be SMALL. Noise impacts would not result from demand-side management initiatives. The NRC staff concludes that the overall noise impacts associated with operation of the combination alternative would be SMALL.

3.4 Geologic Environment

This section describes the geologic environment of the North Anna site and vicinity, including landforms, geology, soils, and seismic conditions. The description of the resources is followed by the NRC staff's analysis of the potential impacts on geologic and soil resources from the proposed action (SLR) and alternatives to the proposed action.

3.4.1 Physiography and Geology

Section 2.4 of the NRC staff's EIS for an ESP at North Anna (NUREG-1811, *Environmental Impact Statement for and Early Site Permit (ESP) at the North Anna ESP Site*) (NRC 2006-TN8385) describes the physiographic and geologic environment of the North Anna site and vicinity. Section E3.5 of Dominion's ER (VEPCO 2020-TN8099) also describes the geologic environment of the site and vicinity and provides a somewhat more detailed summary focusing on the North Anna site. The staff incorporates the information in NUREG-1811, Section 2.4 (NRC 2006-TN8385: p. 2-18, 2-19), here by reference, with key information summarized as follows.

The North Anna site is located along the shore of Lake Anna within the central Piedmont physiographic province between the Blue Ridge province to the west and the Coastal Plain province to the east. The topography of the Piedmont is characterized by relatively low, rolling hills with elevations ranging up to 1,500 ft (460 m) above mean sea level (msl). The topography of the North Anna site is characterized as gently undulating, with elevations varying from about 200 ft (60 m) to 500 ft (152 m) above msl.

Hard, crystalline igneous and metamorphic rock formations dominate the site region, with some areas of sedimentary rocks and saprolite or residuum deposits (deeply weathered rock) overlying the crystalline bedrock. The geologic formations have undergone a complex history of deposition, uplift, deformation, and subsequent erosion. The size and number of fractures and joints in the bedrock decrease with depth as the bedrock becomes less weathered and more structurally competent. In contrast, the crystalline metamorphic rocks nearer to the ground surface have undergone extensive weathering to create a layer of saprolite up to about 100-ft (30-m) thick beneath the site (NRC 2006-TN8385). The saprolite is either exposed at the surface or is overlain by soil or fill material (VEPCO 2020-TN8099).

3.4.2 Geologic Resources

The North Anna region was, historically, a host to mining operations for iron, copper, sulfur, gold, and other ores, as well as quarrying for whetstone (NRC 2006-TN8385). However, there are currently no mining activities within 10 mi (16 km) of the North Anna nuclear power plant site (VEPCO 2020-TN8099). In addition, the saprolitic or residual materials that overlie the bedrock across the site are not suitable for structural backfill (NRC 2006-TN8385).

3.4.3 Soils

Native soils and underlying saprolitic materials were disturbed during nuclear power plant construction. Soil unit mapping by the Natural Resources Conservation Service identifies site soils found in and near the North Anna nuclear power plant complex and extending north and east to the lake and along the discharge canal, as cut and fill land (VEPCO 2020-TN8099; USDA 2020-TN8402). The soils located in relatively undisturbed areas surrounding the nuclear power plant complex to the west, north, and south predominantly consist of sandy loams derived from bedrock residuum. The majority of these soils on flat uplands are rated as prime farmland or farmland of statewide importance. However, the mapping shows that the majority of these soils are rated as somewhat to very limited for building site development due to such factors as slope, depth to bedrock, depth to saturated zone, soil shrink-swell potential, and other factors. The soils generally have a slight-to-moderate erosion hazard, except in eroded and steeply sloped areas where the hazard is moderate to severe (USDA 2020-TN8402). Nevertheless, soils and fill materials across developed areas of the site are less prone to erosion due to stabilization measures, and Dominion maintains a Stormwater Pollution Prevention Plan (SWPPP) for the North Anna site that includes soil erosion and sediment control measures to prevent erosion and potential water quality impacts (VEPCO 2020-TN8099). Section E3.5 of Dominion’s ER (VEPCO 2020-TN8099) provides a more detailed description of soils across the North Anna site.

3.4.4 Seismic Setting

North Anna is located in an area of elevated seismicity known as the Central Virginia Seismic Zone (CVSZ) that experiences persistent seismic (earthquake) activity of generally low magnitude (VEPCO 2020-TN8099; VDMME 2021-TN8548). The CVSZ eastern boundary is roughly elliptical and begins along the fall line near Richmond, Virginia, extending about 75 mi (120 km) to the west toward the Blue Ridge Mountains and approximately 60 mi (100 km) along a north-south axis (Horton et al. 2015-TN8547; Tarr and Wheeler 2006-TN8433). The North Anna site is located near the northern boundary of the CVSZ. The locations of historical earthquake epicenters in this seismic zone are well distributed; however, recent mapping indicates a concentration of activity along the South Anna River (VDOE 2023-TN8493). The area corresponds to a thrust fault (Long Branch Fault) approximately 22 km south-west of the site. The site is located in an area predicted to experience earthquake-induced peak horizontal ground accelerations between 0.1–0.2 *g* (based on a 2 percent probability of exceedance in 50 years), which is less than that of the acceleration needed to cause damage to buildings of good design (Petersen et al. 2020-TN7281).

From 1970 through February 2023, 44 earthquakes with a magnitude equal to, or greater than, 2.5 have been recorded within a 50-mi (80-km) radius of the North Anna site (USGS 2023-TN8807). This list includes the August 23, 2011, Central Virginia (Mineral) earthquake. As is common with strong earthquakes, of the 44 earthquakes since 1970, approximately 20 are aftershocks associated with the 2011 Mineral earthquake.

The Mineral earthquake epicenter was 8.7 mi (14 km) south-southeast of Louisa, Virginia, and approximately 10 mi (16 km) southwest of the North Anna site with a 5.8 moment magnitude (USGS 2021-TN6951, USGS 2021-TN8405). This earthquake stands as the largest and most damaging seismic event in the Eastern United States since the Charleston, South Carolina, earthquake of 1886 (estimated 7.0 moment magnitude) (Horton et al. 2015-TN8547).

The Mineral earthquake produced very strong to severe shaking near the epicenter and caused significant damage to many homes and other structures. With decreasing intensity with distance from the epicenter, relatively strong shaking also occurred across the North Anna site (USGS 2021-TN8405; VDMME 2021-TN8548).

At the time of the 2011 Mineral earthquake, North Anna were operating at full power. In accordance with designed safety features, the earthquake caused a series of trip signals to both reactors, as well as a loss of offsite power to the nuclear power plant. Following the earthquake, Dominion ensured a safe shutdown condition and then restored offsite power. NRC regulations required that the nuclear power plant remain shut down until the licensee could demonstrate to the NRC that no functional damage occurred to those features necessary for continued safe operation (NRC 2011-TN8494).

During the shutdown period, Dominion personnel performed inspections, testing, and analyses in accordance with applicable guidance to verify that no functional damage occurred as a result of the earthquake and that the nuclear power plant could operate without undue risk to the health and safety of the public (VEPCO 2020-TN8099; NRC 2011-TN8494). NRC inspection teams performed independent technical evaluations and assessed Dominion’s readiness for restart. The NRC staff concluded that the licensee performed adequate inspections, walkdowns, and testing to ensure that safety-related structures, systems, and components had not been adversely affected by the earthquake, and that Units 1 and 2 could be operated without undue risk to the health and safety of the public (NRC 2011-TN8494). Subsequently, on November 11, 2011, the NRC approved the restart of North Anna, with Unit 1 restarting on November 14, 2011, and Unit 2 on November 21, 2011.

Following the restart of North Anna, Dominion implemented a long-term seismic margin management plan to further ensure that the nuclear power plant can continue to operate safely and without undue risk in the event of another earthquake. This plan requires that the design change process and qualification of new and replacement equipment at North Anna account for the Mineral earthquake (VEPCO 2018-TN8475, VEPCO 2020-TN8099). Dominion’s updated final safety analysis report (VEPCO 2018-TN8475) further documents the scope of this plan.

The NRC evaluates the potential effects of natural hazards, including seismic events, on nuclear power plants on an ongoing basis, separate from the license renewal process. Before the 2011 Mineral earthquake, the NRC established the Near-Term Task Force following the accident at the Fukushima Dai-ichi nuclear power plant resulting from the March 11, 2011, Great Tohoku Earthquake and subsequent tsunami, as directed by the Commission on March 23, 2011 in COMGBJ-11-0002 (NRC 2011-TN7448). The Near-Term Task Force assessment resulted in the NRC issuing three orders (EA-12-049, EA-12-050, and EA-12-051) on March 12, 2012, to nuclear power plant licensees to mitigate beyond-design-basis events; NRC issued 10 CFR 50.54(f) letters directing licensees to conduct seismic and flooding reevaluations (NRC 2012-TN2198; 10 CFR Part 50-TN249). In response to these NRC actions, Dominion performed a number of follow-up actions at North Anna, which were subject to NRC oversight. In June 2020, the NRC staff issued its determination that Dominion had implemented NRC-mandated safety enhancements at North Anna in response to the NRC orders and that it had also completed its response to the 10 CFR 50.54(f) letter (NRC 2020-TN8336).

In addition, and in consideration of the lessons learned following the Fukushima Dai-ichi accident, the NRC staff developed an enhanced process to ensure the ongoing assessment of information on a range of natural hazards that could potentially pose a threat to nuclear power plants. The framework developed as part of this process provides a graded approach that allows the NRC to proactively, routinely, and systematically seek, evaluate, and respond to new hazard information (NRC 2016-TN7238). In 2017, the Commission approved the staff’s process enhancements for an ongoing assessment of natural hazard information (NRC 2017-TN5851).

3.4.5 Proposed Action

The following sections address the site-specific environmental impacts of North Anna SLR on the environmental issues identified in Table 3-1 that relate to geology and soils.

The impacts on geology and soils were not considered in the 1996 LR GEIS (NRC 1996-TN288), and therefore were not considered in the 2002 North Anna LR SEIS (NRC 2002-TN8296). In this section, the NRC staff findings regarding these impacts at the North Anna site for the SLR term are discussed, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN8272).

Although no license renewal-related construction activities are planned or anticipated (VEPCO 2020-TN8099), the impact of continued operation and any refurbishment associated with license renewal at the North Anna site on geologic and soil resources could include soil disturbance for projects, such as replacing or adding buildings, roads, parking lots, and below-ground and above-ground utility structures. For such projects, the licensee may also need to obtain geologic resources (e.g., soil or sand borrow or backfill material, aggregate for road building or concrete production) from locations on the nuclear power plant site or from offsite borrow areas or quarries. However, it is more likely that these materials would be obtained from commercial vendors. Regardless, stabilization measures to prevent erosion and sedimentation impacts to the North Anna site and surrounding area have been in place since construction began in the early 1970s and a Storm Water Pollution Prevention Plan (SWPPP) was implemented in 2015 (VEPCO 2020-TN8099). The SWPPP identifies BMPs to prevent or reduce soil erosion and subsequent impacts on surface water quality. These include nonstructural preventative measures and structural controls to prevent erosion or treat stormwater impacted by potential pollutants caused by erosion. Any ground-disturbing activities at the North Anna site would be subject to and managed by the current SWPPP and any ground disturbance of one or more acres would require a construction stormwater permit to be obtained from the VDEQ (VEPCO 2020-TN8099).

In addition to erosion prevention measures, the Farmland Protection Policy Act of 1981 (7 USC 4201 et seq. TN708) requires Federal agencies to take into account agency actions affecting the preservation of farmland, including prime and other important farmland soils, as described in Section 3.3.4. However, the site is not subject to the Farmland Protection Policy Act because the act does not apply to Federal permitting or licensing for activities on private or non-Federal lands.

The impacts of natural phenomena, including geologic hazards, on nuclear power plant systems, structures, and components are outside the scope of the NRC's license renewal environmental review. Nonetheless, in its license renewal environmental review, the NRC considers the risk to reactors from seismicity in its evaluation of severe accidents. North Anna was originally sited, designed, and licensed in consideration of applicable geologic and seismic criteria, and seismic issues are assessed as part of the nuclear power plant safety review. As discussed in Section 3.3.5, the site adheres to a long-term seismic margin management plan, implemented NRC-mandated safety enhancements in response to NRC orders EA-12-049, EA-12-050, and EA-12-05, and completed seismic and flooding reevaluation as per its 10 CFR 50.54(f) letter (TN249). The impacts of natural phenomena, including geologic hazards, on nuclear power plant systems, structures, and components are outside the scope of the NRC's license renewal environmental review. Nonetheless, in its license renewal environmental review, the NRC considers the risk to reactors from seismicity in evaluation of severe accidents. North Anna was originally sited, designed, and licensed in consideration of applicable geologic and seismic criteria, and seismic issues are assessed as part of the nuclear power plant safety review. As discussed in Section 3.3.5, the site adheres to a long-term seismic margin management plan, implemented NRC-mandated safety enhancements in response to NRC orders EA-12-049, EA-12-050, and EA-12-05, and completed seismic and flooding reevaluation as per its 10 CFR 50.54(f) letter (TN249).

Further, the NRC requires all licensees to take seismic activity into account to maintain safe operating conditions at all nuclear power plants. When new seismic hazard information becomes available, the NRC evaluates the new information to determine if any changes are needed at existing nuclear power plants, as discussed in Section 3.3.5. This Reactor Oversight Process, which considers seismic safety, is separate and distinct from the NRC staff's license renewal environmental review.

Geologic and soil conditions at North Anna and associated transmission lines have been well established during the current licensing term. These conditions are expected to remain unchanged during the 20-year SLR term. Under an SLR, current operating conditions and environmental stressors would continue rather than wholly new impacts being introduced. For these reasons, the effects on geology and soil would be minor and would neither destabilize nor noticeably alter any important attribute of this resource during the SLR term. The NRC staff concludes that the impacts to geology and soil during the North Anna SLR term would be SMALL.

3.4.6 No-Action Alternative

Under the no-action alternative there would be few or no incremental impacts on site geology and soils associated with the shutdown of North Anna Units 1 and 2. This is because, before beginning decommissioning activities, little or no new ground disturbance would occur at the nuclear power plant site while operational activities are reduced and eventually cease. As a result, the NRC staff concludes that the impact of the no-action alternative on geology and soils would be SMALL.

3.4.7 Replacement Power Alternatives: Common Impacts

Construction

During facility construction for both replacement power alternatives and associated components, aggregate material (such as crushed stone, riprap, sand, and gravel) would be required to construct buildings, foundations, roads, parking lots, pad sites, transmission lines, and other supporting infrastructure, as applicable. The NRC staff presumes that these resources would be obtained from commercial suppliers using local or regional sources. Land clearing, grading, and excavation work expose soils to erosion and alter surface drainage. The NRC staff also presumes that BMPs would be implemented in accordance with applicable State and local permitting requirements to reduce soil erosion and associated offsite impacts. These practices would include such measures as the use of sediment fencing, staked hay bales, check dams, sediment ponds, riprap aprons at construction and laydown yard entrances, mulching and geotextile matting of disturbed areas, and rapid reseeding of temporarily disturbed areas, where applicable. Standard construction practice dictates that topsoil removed during construction and any suitable excavated materials would be stored on site for redistribution, such as for backfill at the end of construction.

Operations

Replacement power facilities would be built in accordance with applicable State and local building codes and would consider such siting and design factors to mitigate potential impacts from natural phenomena. Once facility construction is completed, areas disturbed during construction, whether on land or offshore, would be within the footprint of the completed facilities, overlain by other impervious surfaces (such as roadways and parking lots), or revegetated or stabilized as appropriate, so there would be no additional land disturbance and no direct operational impacts on geology and soils. Consumption of aggregate materials or topsoil for maintenance purposes during operations would be negligible.

3.4.8 New Nuclear (Small Modular Reactor) Alternative

The impacts on geologic and soil resources from construction and operations associated with the new nuclear alternative would likely be similar to but somewhat greater than those described and assumed as common to all alternatives in Section 3.3.8. Implementation of this alternative would use existing infrastructure at the North Anna site to the maximum extent possible, which would reduce construction impacts and connected impacts on site geology and soils, as well as consumption of geologic resources for new facility construction. However, excavation work for the power block may extend to a depth of about 140 ft (43 m) below grade. Blasting of bedrock would be necessary, and construction of ramps along with bracing would likely be required to access and maintain deep excavations during construction. Site construction work would also require the use and consumption of engineered backfill, which would likely need to be procured from offsite regional sources and transported to the site. Nevertheless, disturbance to geologic strata and soil erosion and loss under this alternative would be localized to the North Anna site, and offsite soil erosion impacts would be mitigated by using BMPs. As a result, the NRC staff concludes that the overall impacts on geology and soil resources from the new nuclear alternative would be SMALL.

3.4.9 Combination Alternative (Solar, Offshore Wind, Small Modular Reactor, and Demand-Side Management)

Under this combination alternative, the impacts on geologic and soil resources would likely be similar to but greater than those described and assumed as common to all alternatives in Section 3.3.8 and greater than those under the new nuclear alternative. This greater potential for impacts is primarily due to the substantial land area, along with additional seafloor areas, that would be disturbed at multiple offsite locations, along with the potential for soil erosion and loss of natural soils and sediments from the conversion of land to industrial uses for the solar photovoltaic and offshore wind component of this alternative. Based on these considerations, the NRC staff concludes that the impacts on geology and soil resources from the combination alternative could range from SMALL to MODERATE.

3.5 <u>Water Resources</u>

This section describes surface water and groundwater resources at and around the North Anna site. The description of the resources is followed by the staff’s analysis of the potential impacts on surface water and groundwater resources from the proposed SLR action and alternatives to the proposed action.

3.5.1 Surface Water Resources

Surface water encompasses all water bodies that occur above the ground surface, including rivers, streams, lakes, ponds, and human-made reservoirs or impoundments.

3.5.1.1 *Surface Water Hydrology*

Local and Regional Hydrology

Section 2.6.1.1 of the NRC staff's EIS for an ESP at North Anna (NUREG-1811) (NRC 2006-TN8385) describes the hydrologic environment of the North Anna site and vicinity. The NRC staff incorporates the information in NUREG-1811, Section 2.6.1.1 (NRC 2006-TN8385: p. 2-20, 2-21), here by reference.

As discussed in NUREG-1811, the dominant water feature of the site is Lake Anna. The reservoir has a normal operating (full) pool level of 250 ft (76.2 m) above msl. The reservoir was formed by impounding the North Anna River above the North Anna Dam. While Dominion uses the reservoir for nuclear and hydroelectric power generation, operation of the reservoir and the dam provides a flood control function while also ensuring sufficient instream flow in the North Anna River below the dam's spillway. The reservoir is further divided into two distinct bodies of water, Lake Anna and the WHTF.

Section E3.6.1 of Dominion's ER provides a similar but more detailed description of the hydrologic setting of Lake Anna and the WHTF, including the operational characteristics of the reservoir, Lake Anna Dam, and the North Anna Hydro Power Station. This information is incorporated here by reference (VEPCO 2020-TN8099: Section E3.6.1, p. E-3-77, E-3-78). In summary, North Anna, uses the WHTF as previously discussed in Section 2.1.3.1 of this EIS. North Anna withdraws water from the reservoir for use in the circulating and service water systems and discharges the cooling water and comingled effluents back to the WHTF. The return flow then travels through the three, interconnected lagoons of the WHTF and enters Lake Anna at Dike 3. Figure 3-1 depicts the surface water features of the region in relation to Lake Anna and the North Anna site.

Flooding

The Federal Emergency Management Agency (FEMA) has delineated the flood hazard areas within and in the vicinity of the North Anna site. FEMA has mapped the majority of the nuclear power plant site as located within Zone X, outside the 0.2 percent annual chance floodplain (500-year flood level). Several small, low areas along the lakeshore and associated with the discharge canal are mapped as Zone AE, within the 100-year flood level with base flood elevations of 255 ft (77.7 m) North American Vertical Datum of 1988 (NAVD88) (VEPCO 2020-TN8099; FEMA 2020-TN8473; VEPCO 2023-TN8534|Response to SWR-8 RCI|).

In accordance with the NRC's General Design Criteria (Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50-TN249, "Domestic Licensing of Production and Utilization Facilities"), nuclear power plant structures, systems, and components important to safety are designed to withstand the effects of natural phenomena, such as flooding, without loss of capability to perform safety functions. North Anna is designed and located such that the nuclear power plant site is protected from flooding by Lake Anna and from local intense precipitation and ponding. The nuclear power plant grade lies above the maximum expected lake surface elevation, including possible wind and wave action. All seismic Category I structures, systems, and components important to safety at North Anna are designed to withstand flooding commensurate with the probable maximum flood (VEPCO 2018-TN8475, VEPCO 2020-TN8099).

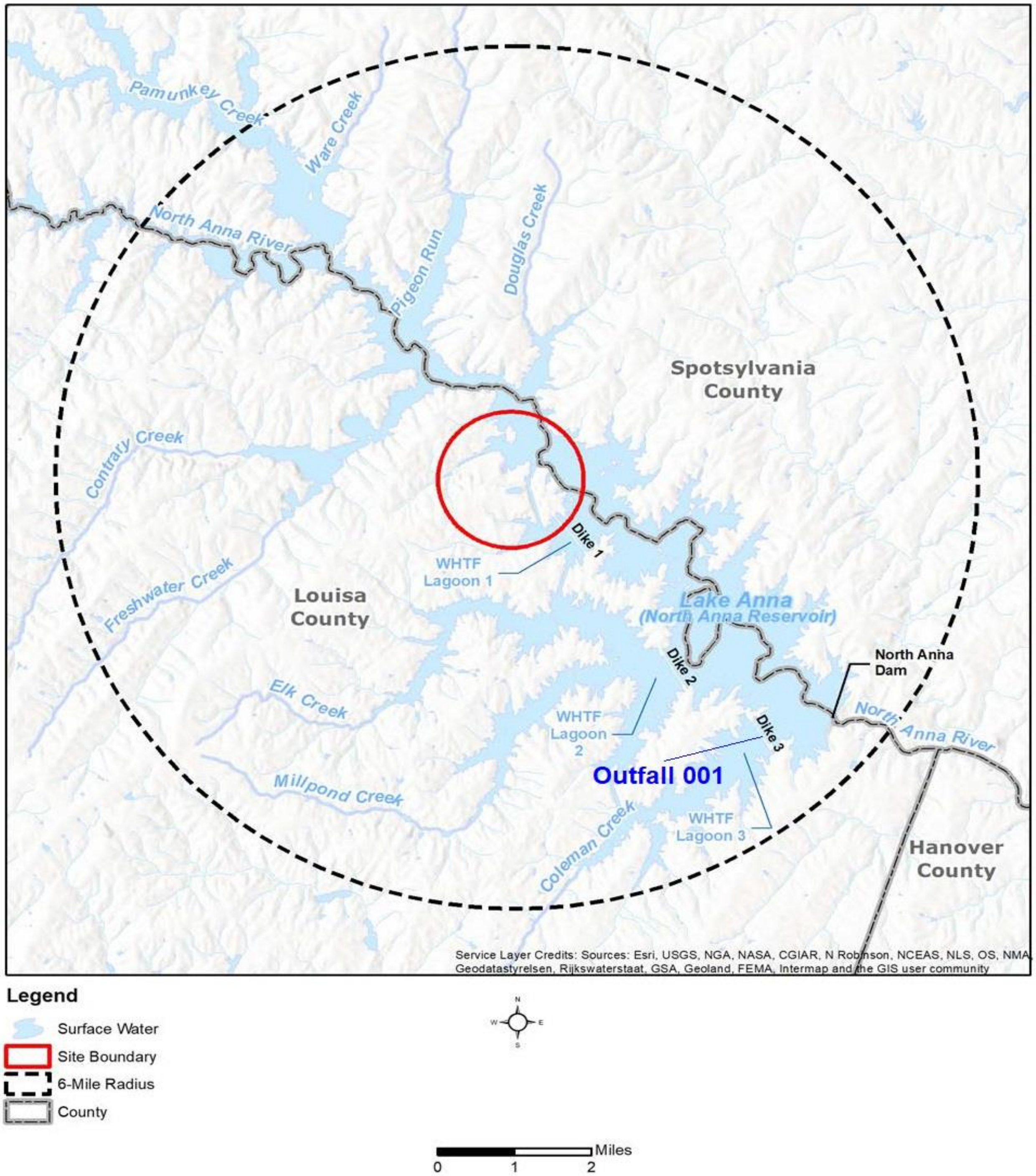


Figure 3-1 Major Surface Water Features Associated with the Lake Anna Watershed. Adapted from: VEPCO 2020-TN8099

Additionally, the NRC evaluates nuclear power plant operating conditions and physical infrastructure to ensure ongoing safe operations through its Reactor Oversight Process. If new information about changing environmental conditions becomes available, the NRC will evaluate the new information to determine whether any safety-related changes are needed.

3.5.1.2 Surface Water Use

As described in Figure 2-3, North Anna withdraws water from Lake Anna for use in the circulating water and service water cooling systems. Heated cooling water, along with comingled effluents from auxiliary systems, is returned to the WHTF and flows back to Lake Anna through a submerged discharge structure at Dike 3 (see Figure 2-3). This discharge location corresponds to Outfall 001, as designated in North Anna's VPDES permit (VEPCO 2020-TN8383).

North Anna's maximum (hypothetical) surface water withdrawal rate from Lake Anna is 1,928,600 gpm (7,290 m^3/min). This rate is equivalent to approximately 2,777 mgd (10,512 mLd). This rate has not changed as previously evaluated by the NRC staff in the EIS for initial license renewal for North Anna (NRC 2002-TN665). Table 3-5 summarizes North Anna's actual surface water withdrawals from 2015 to 2022.

Table 3-5 Surface Water Withdrawals, North Anna Nuclear Power Plant (2015–2021)

Year	Yearly Withdrawals (mgy)	Daily Withdrawals (mgd)[(a)]
2015	703,030	1,926.1
2016	652,780	1,783.6
2017	706,850	1,936.6
2018	687,360	1,883.2
2019	663,570	1,818.0
2020	696,922	1904.2
2021	677,283	1,855.6
2022	663,785	1,818.6
Average	681,448	1,865.7

(a) All reported values are rounded. To convert million gallons per year (mgy) to million cubic meters (m^3) divide by 264.2. To convert million gallons per day (mgd), to million liters per day (mLd), multiply by 3.7854.
Sources: VEPCO 2020-TN8099: p. E-3-101,
VEPCO 2022-TN8270: p. E-4-29,
VEPCO 2023-TN8534|Response to SWR-2/SWR-5 RCI|.

Actual consumptive water use is not measured at North Anna. As described by the NRC staff in Sections 3.5.1.1 and 4.5.1.1 of the LR GEIS (NRC 2013-TN2654), consumptive water use of once-through heat dissipation systems like those at North Anna is a small fraction of the amount of water withdrawn. The NRC staff estimates North Anna's consumptive water use to be roughly 22 mgd (83 mLd), or approximately 1 percent of the nuclear power plant's average withdrawal rate over the last 5 years.

The average surface water withdrawal rate by the nuclear power plant in 2021 was reported as 1,855.57 mgd (7,024.08 mLd) and averaged 1,865.7 mgd (7,062.42 mLd) between 2015 and 2022. (VEPCO 2020-TN8099, Table E3.6-4a, p. E-3-101; VEPCO 2022-TN8476, Table E4.5-1a, p. E-4-29, VEPCO 2023-TN8534|Response to SWR-2/SWR-5 RCI). The 2021 average daily withdrawal amount represents about 11.4 percent of the conservation and active storage volume of Lake Anna (VEPCO 2020-TN8099: Section E3.6.3.1). Note that in the SLR ER Section E3.6.3.1 and Section E6.3.2, the 2019 nuclear power plant's daily average withdrawal value was incorrectly cited as 2 percent (VEPCO 2020-TN8099). The correct daily average withdrawal is about 11.4 percent. Lake Anna is not used as a drinking water source by either the nuclear power plant or the community. There are no public water supplies within 5 miles of the outfalls.

Aside from North Anna operations, surface water withdrawals from Lake Anna are primarily non-consumptive in nature and are associated with recreational use. Dominion has not identified any proposed future surface water withdrawals that would affect the watershed of the reservoir (VEPCO 2020-TN8099). Withdrawals from and impoundments of surface waters within Virginia normally require a water protection permit. No water protection permit is required for any water withdrawal that was in existence on July 1, 1989; however, a permit is required if a new certification under Section 401 of the CWA, as amended, is required to increase a withdrawal (Code of Virginia, Title 9-TN8604 25-210-310). For example, as stated below, North Anna Unit 3 required such a permit to address the anticipated increase in water withdraw from the proposed additional unit. Since North Anna has been in operation since before July 1, 1989, Dominion is exempt from needing a Virginia water protection permit for North Anna Unit 1 and 2 operations (VEPCO 2020-TN8099). In addition, Dominion does not plan to increase North Anna's surface water withdrawals, and it would not be required to obtain a water protection permit absent an increase in withdrawals.

3.5.1.3 Surface Water Quality and Effluents

Water Quality Assessment and Regulation

In accordance with Section 303(c) of the CWA (33 U.S.C. 1251–1387; TN662), States have the primary responsibility for establishing, reviewing, and revising water quality standards for U.S. navigable waters. Such standards include the designated uses of a water body or water body segment, the water quality criteria necessary to protect those designated uses, and an antidegradation policy with respect to ambient water quality. As established under CWA Section 101(a), water quality standards are intended to restore and maintain the chemical, physical, and biological integrity of U.S. waters and to attain a level of water quality that provides for designated uses. The EPA reviews each State's water quality standards to ensure they meet the goals of the CWA and Federal water quality standards regulations (40 CFR Part 131-TN4814, "Water Quality Standards"). VDEQ issues surface water quality standards in Virginia in accordance with its regulations codified at Code of Virginia, 9 VAC 25–260 (TN8604).

CWA Section 303(d) requires States to identify all "impaired" waters for which effluent limitations and pollution control activities are not sufficient to attain water quality standards in such waters. Similarly, CWA Section 305(b) requires States to assess and report on the overall quality of waters in their State. States prepare a CWA Section 303(d) list that identifies those water quality limited stream segments that require the development of total maximum daily loads to assure future compliance with water quality standards. The list also identifies the pollutant or stressor causing the impairment and establishes a priority for developing a control plan to address the impairment. The total maximum daily loads specify the maximum amount of a pollutant that a water body can receive and still meet water quality standards. Once established, total maximum daily loads often are implemented through watershed-based programs administered by the State, primarily through permits issued under the National Pollutant Discharge Elimination System (NPDES) permit program, under CWA Section 402, and associated point and nonpoint source water quality improvement plans and associated BMPs. States are required to update and resubmit their impaired waters list every 2 years, which ensures that impaired waters continue to be monitored and assessed by the State until applicable water quality standards are met.

The VDEQ monitors ambient water quality across Lake Anna (VEPCO 2020-TN8099). In addition, the VDEQ issued its draft integrated CWA Section 303(d)/305(b) report in June 2020 (VDEQ 2020-TN8420). Overall, the waters of Lake Anna fully support its designated uses for aquatic life, recreation, and wildlife. However, the upper portion of the reservoir near the nuclear power plant site and south to near Dike 1 (see Figure 3-1 is impaired for fish consumption due to polychlorinated biphenyls (PCBs) in fish tissue. Further, the more southward portion of the reservoir is impaired for fish consumption due to both PCBs and mercury in fish tissue. VDEQ has not determined the sources of these pollutants (VDEQ 2020-TN8420, VDEQ 2020-TN8477).

Virginia Pollutant Discharge Eliminating System Permitting Status and Nuclear Power Plant Effluents

To operate a nuclear power plant, NRC licensees must comply with the CWA, including associated requirements imposed by the EPA or the State, as part of the NPDES permitting system under CWA Section 402. The Federal NPDES permit program addresses water pollution by regulating point sources (i.e., pipes, ditches) that discharge pollutants to waters of the United States. All NRC licensees must meet State water quality certification requirements under CWA Section 401. The Environmental Protection Agency or the States, not the NRC, sets the limits for effluents and operational parameters in nuclear power plant-specific NPDES permits. Nuclear power plants require a valid NPDES permit and a current Section 401 Water Quality Certification to operate.

The EPA authorized the Commonwealth of Virginia to assume NPDES program responsibility. The VDEQ administers the program through its issuance of VPDES permits. The Commonwealth’s regulations for administering the VPDES program are contained in Virginia Administrative Code (Code of Virginia, Title 9-TN8604). The VDEQ issues VPDES permits on a 5-year cycle.

North Anna is authorized to discharge various wastewater (effluent) streams under VPDES Permit VA0052451. The most recent version of this permit has an effective date of May 8, 2014, and it expired on May 7, 2019 (VEPCO 2020-TN8383). Dominion submitted a timely and complete VPDES permit renewal application to VDEQ in October 2018 (VEPCO 2021-TN8268). Therefore, the current 2014 permit remains valid and in force. In March 2019, Dominion submitted supplemental information for its VPDES permit renewal application (VEPCO 2021-TN8268). The NRC staff reviewed Dominion’s VPDES renewal application and supplemental materials. The staff found that Dominion has not proposed any substantial changes in North Anna’s effluent discharges with consequences for the proposed SLR term.

North Anna’s current VPDES permit authorizes monitored discharge from 28 outfalls in total, including 10 external outfalls (seven industrial process wastewater and three stormwater) and 18 internal outfalls (16 industrial process wastewater and two stormwater). External outfalls discharge directly to a surface water body or to a feature that connects directly to a water body, while internal outfalls contribute flow to other waste stream(s) before collectively discharging into an external outfall. Figure 3-2 shows the locations of all major outfalls except for Outfall 001. At North Anna, external Outfall 001 is the combined discharge and monitoring point for all non-contact cooling water return flows and nuclear power plant effluents that enter the WHTF, as shown in Figure 3-1. Non-contact cooling water discharges are discharges that do not contain or come in contact with raw materials, intermediate products, finished products, or process wastes in a facility (40 CFR 401.11; TN8478).

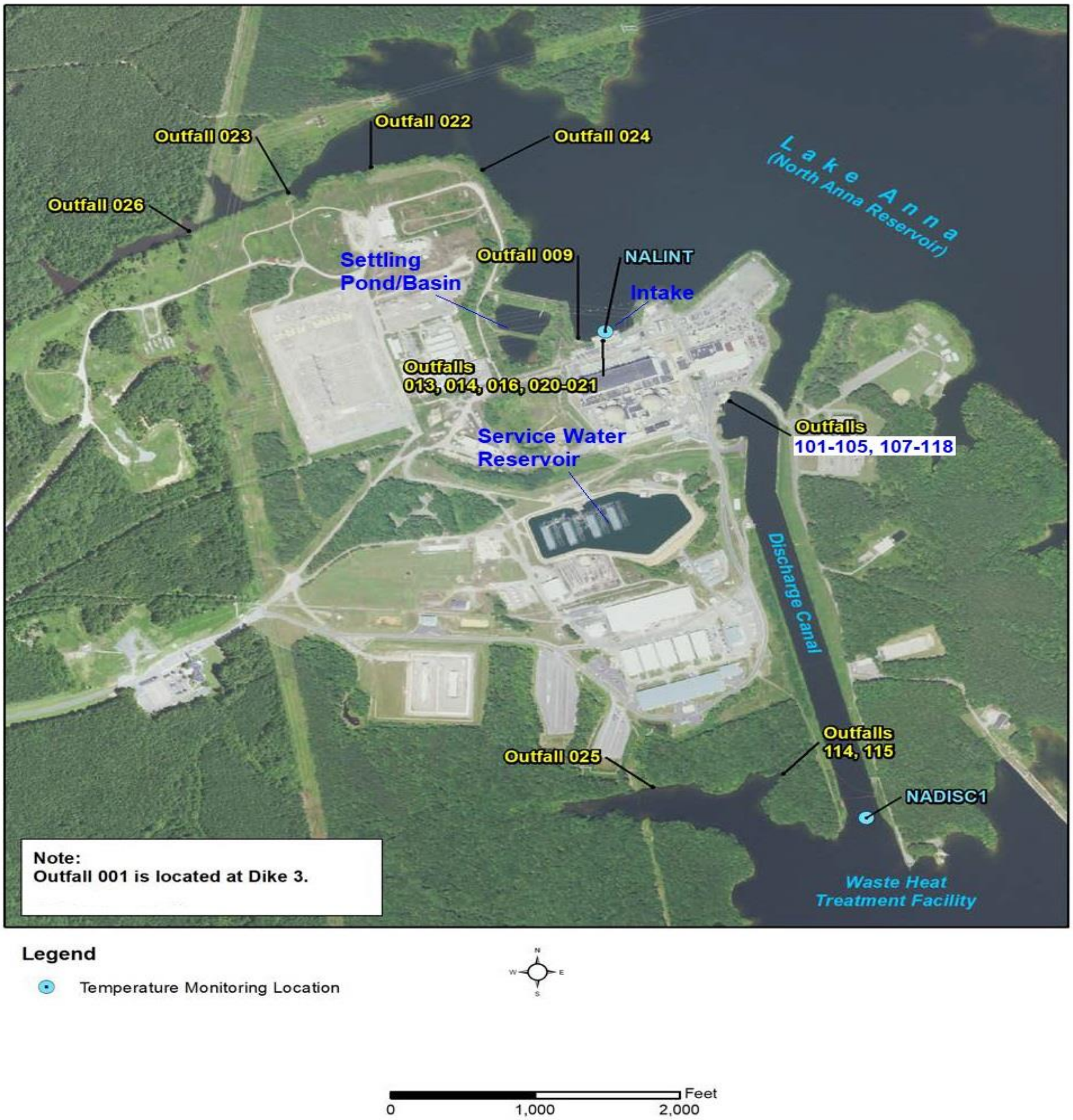


Figure 3-2 North Anna Virginia Pollutant Discharge Elimination System Permitted Outfalls and Temperature Monitoring Points. Adapted from: VEPCO 2020-TN8099; VEPCO 2020-TN8383

North Anna's VPDES permit (VEPCO 2020-TN8383) specifies the pollutant-specific discharge limitations and monitoring requirements for effluents discharged through each outfall to ensure that North Anna's discharges comply with applicable water quality standards. Depending on the outfall, Dominion is required to monitor flow rate, total suspended solids, pH, heat rejection, temperature, total residual chlorine, oil and grease, biochemical oxygen demand, total suspended solids, metals, nutrients, and other specified parameters. In addition, under its VPDES permit, Dominion must notify and seek approval from VDEQ before using any new biocides or chemical additives that could alter North Anna's effluent quality. Table E3.6-2 in Dominion's ER (VEPCO 2020-TN8099) summarizes Dominion's effluent (water quality) monitoring requirements under VPDES Permit VA0052451, including a description of the processes that contribute flow to each outfall. The NRC staff incorporates the information in ER Table E3.6-2 (VEPCO 2020-TN8099: Table E3.6-2, p. E-3-92 through E-3-96) here by reference.

Most notably, North Anna's VDPES permit VA0052541 limits the heat rejected from the nuclear power plant's condenser cooling water flow to the WHTF to 13.54 × 10^9 BTU/hour. This calculated value applies at internal Outfall 101. However, the permit imposes no numeric temperature limits on North Anna's cooling water discharges. Dominion maintains a CWA Section 316(a) variance for North Anna's thermal discharges. Under North Anna's VPDES permit, Dominion is required to conduct routine temperature and biological monitoring (fish population surveys) of Lake Anna, the WHTF, and the North Anna River (VEPCO 2020-TN8099, VEPCO 2020-TN8383). Water temperature is monitored at 10 stations located in the reservoir and WHTF using continuous recorders. Dominion also monitors cooling water intake and discharge temperatures at two monitoring stations (NALINT and NADISC1, respectively) as shown in Figure 3-2. Dominion does not plan any facility modifications or operational changes for the proposed SLR term that would change North Anna's thermal discharges (VEPCO 2020-TN8099).

Treated, low-level radioactive liquids are intermittently discharged from the nuclear power plant's liquid waste disposal system through internal Outfall 101 (VEPCO 2020-TN8383). The release point is in the circulating discharge tunnel that ultimately leads to the discharge canal and the WHTF. Dominion conducts these releases to ensure that they are ALARA and meet the limits in 10 CFR Part 20 (TN283), "Standards for Protection Against Radiation," in receiving waters. In addition to periodic sampling of the waste streams, the discharge is continuously monitored, and Dominion can isolate the discharge based on a signal from the radiation monitor (VEPCO 2020-TN8099).

Five external stormwater outfalls (numbers 014, 022, 024, 025, and 027) receive flow from industrial areas of the nuclear power plant site. Outfall 009 is the discharge from a large settling pond/basin, depicted in Figure 3-2, that receives both process wastewater and stormwater. Dominion maintains a SWPPP that identifies the sources of pollution to comply with the stormwater management conditions of North Anna's VPDES permit. The SWPPP is intended to identify sources of stormwater pollution and document control measures, including BMPs, to eliminate or reduce pollutants in all stormwater discharges from the facility while meeting effluent limitations (VEPCO 2020-TN8099, VEPCO 2020-TN8383).

Dominion operates an onsite sewage treatment plant to manage sanitary wastewater from most of the nuclear power plant site and associated workforce. The sewage treatment plant has a treatment capacity of 30,000 gallons per day (114,000 liters per day). Wastewater treatment includes an extended aeration. The sewage treatment plant monitors and discharges treated effluent at internal Outfall 101 in accordance with North Anna's VPDES permit. Sanitary wastewater from the North Anna Nuclear Information Center and security training building is treated and disposed of through septic systems (VEPCO 2020-TN8099).

For all monitored effluent parameters, Dominion submits discharge monitoring reports to VDEQ in accordance with the reporting schedule specified in North Anna's VPDES permit. Dominion reports that it has not received any notices of violation between 2015 and 2020 and has maintained compliance with North Anna's VPDES permit over this time frame (VEPCO 2020-

TN8099, VEPCO 2021-TN8179). The NRC staff's review of the EPA 's Enforcement and Compliance History Online system 3-year compliance history (January 2016 through January 2019) revealed no notices of violation and no permit exceedances during this period (EPA 2020-TN8492).

Other Surface Water Resources Permits and Approvals

An applicant (in this case, Dominion) for a Federal license to conduct activities that may cause a discharge of regulated pollutants into navigable waters of the United States is required by CWA Section 401 to provide the licensing agency (in this case, the NRC) with water quality certification from the State (in this case, the Commonwealth of Virginia). This certification denotes that discharges from the project or facility to be licensed will comply with CWA requirements and will not cause or contribute to a violation of State water quality standards. If the applicant has not received a Section 401 certification, the NRC cannot issue a license (new or renewed) unless the State has waived the requirement.

The NRC recognizes that some NPDES-delegated States explicitly integrate their CWA Section 401 certification process with NPDES permit issuance. In a letter to Dominion dated September 16, 2020, VDEQ indicated that existing authorizations issued for North Anna facility operations remain valid. Specifically, VDEQ stated, in part, that "[T]he VWP [Virginia Water Protection] permit issued to North Anna station, VWP permit 10-2001, … is the Commonwealth's § 401 Certification for the North Anna Power Station" (VEPCO 2021-TN8268). The NRC staff concludes that Dominion has provided the necessary certification under CWA Section 401(a)(1) to support SLR for North Anna.

CWA Section 404 governs the discharge of dredge and fill materials to navigable waters, including wetlands, primarily through the U.S. Army Corps of Engineers (USACE) permits and applicable State-level permitting programs, such as the Virginia Water Protection Compliance Program. However, Dominion does not conduct maintenance dredging in the North Anna nuclear power plant intake area, discharge canal, WHTF, or Lake Anna (VEPCO 2020-TN8099). Therefore, Dominion does not maintain permits applicable to dredge and fill activities.

3.5.2 Groundwater Resources

This section describes the groundwater flow systems (aquifers) and water quality in and around the North Anna site. Aquifers are a geologic formation, group of formations, or part of a formation that contain sufficient saturated, permeable material to yield significant quantities of water to wells and springs.

3.5.2.1 Local and Regional Groundwater Resources

Section 2.6.1.2 of the NRC staff's EIS for an ESP at North Anna (NUREG-1811) (NRC 2006-TN8385) describes groundwater and the hydrologic environment near the North Anna site. The NRC staff incorporates the information in NUREG-1811, Section 2.6.1.2 (NRC 2006-TN8385: p. 2-20, 2-21), here by reference.

As discussed in NUREG-1811, the North Anna site lies within the Piedmont province. Within the province and the vicinity of the North Anna site, groundwater occurs in the fractured crystalline rocks and in the overlying regolith, comprised of residual soils and well-weathered rock (referred to as saprolite), as shown in Figure 3-3. Aquifer recharge in this region is predominately from local infiltration of precipitation. The regional water table is considered a subdued reflection of the ground surface; therefore, the groundwater generally flows from ridges to valleys or to lowlying areas and surface water bodies such as Lake Anna. Groundwater in the saprolite and the underlying bedrock are hydraulically connected with relatively rapid transport in the aquifer (VEPCO 2020-TN8099). The estimated groundwater velocity at the North Anna site is 0.35 ft/day toward Lake Anna (VEPCO 2020-TN8099). The hydraulic connection between the groundwater and Lake Anna could also result in recharge from the lake into the adjacent aquifer during groundwater pumping or when lake levels are high. The Lake Anna Special Area Plan indicates that average well yields are higher in areas adjacent to the lake than in other areas of the watershed, concluding that these higher yields are likely due to pumping-induced groundwater recharge from the lake (Lake Anna 2000-TN8435).

Groundwater levels in the protected area of the plant are influenced by plant structures, fill materials, and the building foundation mat sumps (VEPCO 2020-TN8099). The sumps maintain groundwater levels in the protected area at lower levels than in the surrounding area, which helps capture and detect any inadvertent radionuclide releases (VEPCO 2021-TN8268). Groundwater levels near Unit 1 vary seasonally by up to 2 ft (VEPCO 2021-TN8268).

3.5.2.2 Local and Regional Water Consumption

Groundwater use in Louisa County was 2.24 million gal (8.48 million L) during 2015 with about 83 percent of this being self-supplied for domestic use (VEPCO 2020-TN8099). The majority of the groundwater used for domestic supply is obtained from wells with a small amount of water obtained from springs (VCE 2023-TN8887). The NRC staff assumed that local groundwater is the principal source of domestic water supply for the population living within the area of the North Anna site. The saprolite well yields in the vicinity of the site are typically low, corresponding to the relatively low permeability of the shallow material. Fracture networks in the crystalline rock aquifers (Figure 3-3) are one of the most important factors affecting bedrock well yields (Powell and Abe 1985-TN8535). Well yields are usually dependent on the presence of water filled fractures within the first 200 ft (61 m) of drilling (Dewberry and Fleming 2011-TN8888). The EPA has designated no sole source aquifers in the Piedmont province of Virginia (EPA 2020-TN8482). A sole source aquifer is an aquifer that supplies at least 50 percent of the drinking water for an associated service area and no reasonably available alternative drinking water sources exist should the aquifer become contaminated.

The well water supply system for North Anna is described in Section 2.1.3.2 and water supply locations are shown in Figure 3-4 (VEPCO 2020-TN8099). North Anna average monthly groundwater withdrawals between 2013 and 2022 ranged from 1.01 gpm (3.82 L/min) to 11.57 gpm (43.80 L/min), with an average monthly withdrawal over this period of 4.99 gpm (18.9 L/min) (VEPCO 2023-TN8534).

3.5.2.3 Groundwater Quality

Section 2.6.3.2 of the NRC staff's EIS for an ESP at North Anna (NUREG-1811) (NRC 2006-TN8385) and Section E3.6.4.2 of the ER (VEPCO 2020-TN8099) describe groundwater quality in the vicinity of the site. In summary, water of the aquifers in the Piedmont physiographic province is generally of good quality; however, as with most crystalline rocks, the mineralogy of the Piedmont bedrock contributes to relatively higher levels of naturally occurring radioactivity in the groundwater. Regional radon activity levels of up to approximately 10,000 pCi/L have been recorded (Zapecza and Szabo 1986-TN9554). Water quality reported in 2016 and 2017 from onsite wells (6, 7, and 8) are consistent with regional water quality measurements (Table E3.6-9b of VEPCO 2020-TN8099). Coliform contamination was identified in groundwater near the North Anna site during a Louisa County water study in 1992 and is likely attributable to private sanitary septic systems in the area (NRC 2006-TN8385).

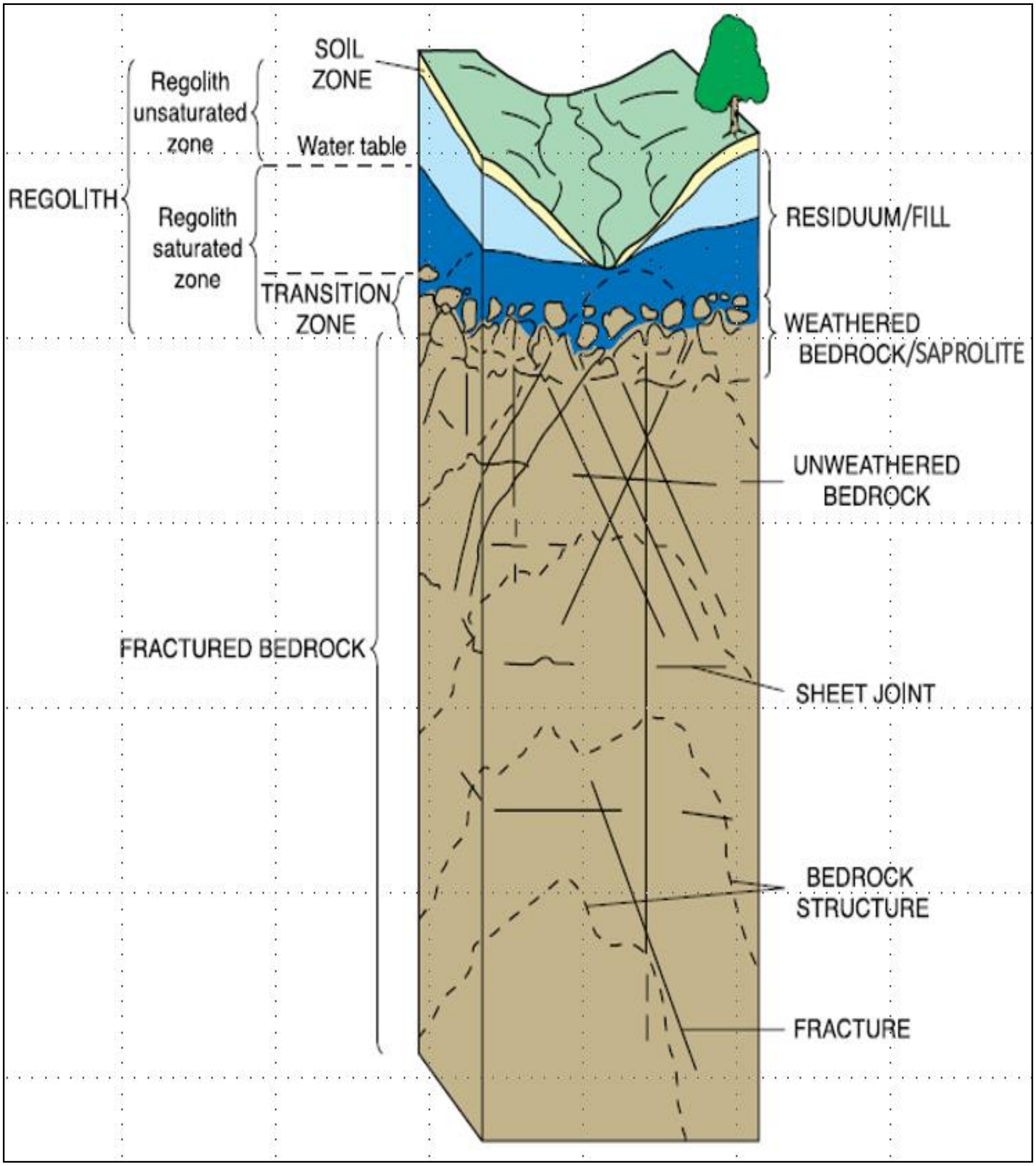


Figure 3-3 Principal Aquifer Components within the Piedmont Province and the North Anna Site. Groundwater Occurs in the Regolith and Fractured Rock. Source: Swain et al. 2004-TN9094

Figure 3-4 Monitoring Wells, Piezometers, and Water Supply Wells at the North Anna Site. Source: Modified from VEPCO 2020-TN8099

Nonradiological Spills

From 2013-2021, no notices of violation, nonconformance notifications, or related infractions received from regulatory agencies associated with permitted effluent discharges, sanitary sewage systems, or groundwater or soil contamination, nor any involving spills, leaks, and other inadvertent releases were documented (e.g., petroleum products, chemicals, or radionuclides) (VEPCO 2020-TN8099, VEPCO 2021-TN8179). A fuel oil leak was noted during 2016 (NRC 2016b) as reported to VDEQ as part of the Underground Storage Tank Program. Dominion remediated the resulting leak, and VDEQ considered the issue closed with no further actions necessary during 2017 (VEPCO 2020-TN8099). In August 2022, an oil spill below a transformer at North Anna Unit 2 occurred, prompting notification of the release to VDEQ and the NRC. Follow-up actions were taken and no impact to groundwater use or quality was reported (VEPCO 2023-TN8534). Following a permitted discharge of test water from the sewage treatment extended aeration tank in 2023, sample test results indicated an exceedance of the permitted pH range. The tank water, which had been discharged to Lake Anna, was secured and notification of the incident were submitted to VDEQ and the NRC.

Radiological Spills

No reportable radiological spills to groundwater have occurred on the North Anna site since 2010, and tritium concentrations have remained below the EPA established maximum contaminant level for drinking water of 20,000 pCi/L since 2014 (40 CFR Part 141-TN4456; VEPCO 2020-TN8099, VEPCO 2023-TN8534). Tritium is produced as a byproduct of nuclear reactors but is also produced naturally in the upper atmosphere when cosmic rays strike nitrogen molecules in the air. Tritium is a hydrogen atom that has two neutrons and one proton in the nucleus or an atomic mass of three. As a gas, tritium can react with oxygen to form water and occurs naturally at very low concentrations in groundwater (EPA 2002-TN8480). Just as nonradiological hydrogen reacts with oxygen to create water, tritium also reacts with oxygen to form “tritiated water” (NRC 2019-TN7805). As a liquid, tritium moves easily through the environment in the same way as non-tritiated water.

Tritium in Groundwater

To rapidly detect potential spills of radionuclides entering groundwater, monitoring wells have been placed close to, within, and around the reactor containment areas (see, Figure 3-4 and Figure 3-5). Table E3.6-3 of the Dominion’s ER (VEPCO 2020-TN8099) shows monitoring well construction data. A total of 26 wells or piezometers have been installed and monitored (VEPCO 2021-TN8268) as part of the Groundwater Protection Program (GWPP), consistent with the industry’s Ground Water Protection Initiative (NRC 2007-TN8483). The GWPP sampling strategy is designed to collect and analyze samples from locations that are downgradient from systems, tanks, or practices that have the potential to release tritium to groundwater. The monitoring data are reported annually in a series of publicly available annual radioactive effluent release reports (NRC 2023-TN9091). The subsurface monitoring interval spans the processed fill (extending 10–17 ft (3–5 m) below ground surface), the weathered soil (below the fill to an approximate depth of 30–33 ft (9–10 m) below ground surface), and the competent bedrock (below the weathered soil). Water samples are analyzed for tritium, gamma-emitting particulates, strontium-89/90, transuranics (alpha-emitting radionuclides having an atomic number greater than 92), and plutonium-241.

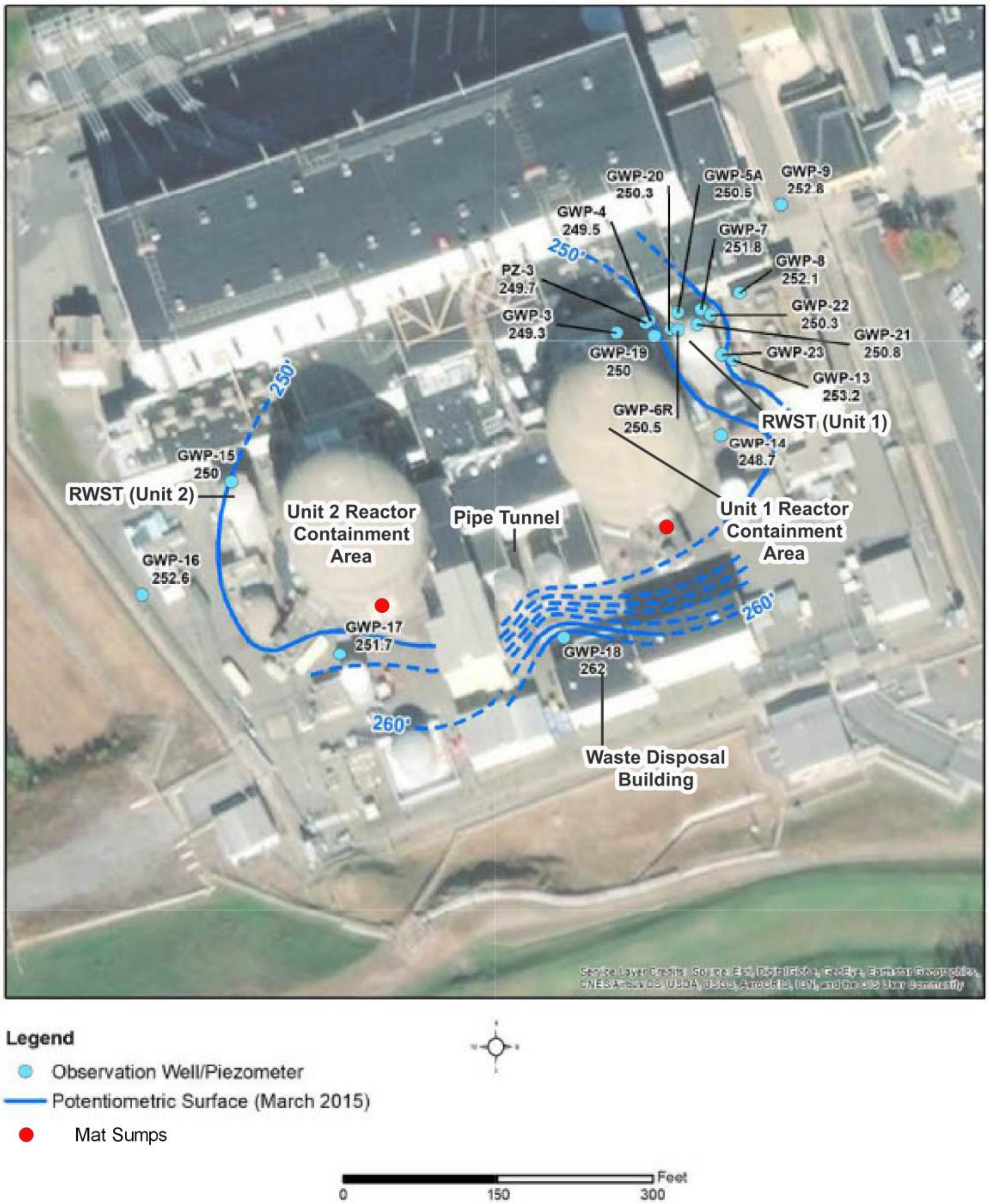


Figure 3-5 Site Features and 2015 Groundwater Level Contours. Adapted from: VEPCO 2020-TN8099

The NRC staff reviewed radioactive effluent release reports published from 2019 to 2023 (VEPCO 2019-TN8392, VEPCO 2020-TN8393, VEPCO 2021-TN8394, VEPCO 2022-TN8476 VEPCO 2023-TN8529). A 5-year dataset is sufficient to encompass a broad range of activities (e.g., refueling outages, routine operation, and maintenance) that may generate radiological effluents and result in corresponding releases to the environment. Based on the review, the NRC staff confirmed that three wells (PZ-3, GWP-6, and GWP-18) have periodically exceeded a Dominion tritium threshold of 5,000 pCi/L (i.e., one-quarter of the EPA drinking water standard).

At one other monitoring well (GWP-3), tritium concentrations exceeded 5,000 pCi/L once during July 2018, reaching 6,087 pCi/L (VEPCO 2021-TN8268). Dominion further investigated tritium concentrations at monitoring wells consistently above the threshold value for potential current and residual sources or release points (VEPCO 2021-TN8268). All monitoring wells have maintained tritium concentrations below the EPA drinking water standard (20,000 pCi/L) from 2018 – 2022 (VEPCO 2019-TN8392, VEPCO 2020-TN8393, VEPCO 2021-TN8394, VEPCO 2022-TN8476, VEPCO 2023-TN8529).

Relatively low shallow-zone tritium concentrations in the vicinity of PZ-3 are consistent with residual concentrations of the overburden soils, which are likely a lingering result of historical releases in the area of the Unit 1 recovery water storage tank (VEPCO 2021-TN8268). Characterizing associated tritium concentrations at PZ-3 as representative of the shallow or deep sampling interval is problematic due to the lack of well construction information. However, concentrations in this well may be used to help identify residual tritium distributions defined by targeted intervals of the nearby monitoring wells (e.g., GWP-6). Inclusive of GWP-6, shallow monitoring wells in the vicinity of PZ-3 indicate that elevated tritium concentrations may be correlated with higher groundwater elevations, likely due to periodic re-saturation of residual tritium sources, leading to the slow leaching of tritium from low permeability shallow zones (VEPCO 2021-TN8268). The slow tritium leaching and limited travel distance from a source is consistent with shallow dye tracer studies that demonstrate a relatively long 2-year travel time from the dye release point to GWP-19, a distance of less than approximately 75 ft (23 m) (VEPCO 2021-TN8268). Upgrades to the monitoring network in 2015, including the replacement of GWP-6 with a larger diameter well, GWP-6R, and the installation of GWP-20, further indicates a shallow source (soil) of tritium (VEPCO 2021-TN8268).

Historically, tritium concentrations at GWP-18 have been relatively consistent with measured concentrations in Lake Anna (VEPCO 2021-TN8268). During August 2019, elevated tritium concentrations at GWP-18 were detected. The maximum sampled concentration peaked at 12,938 pCi/L before returning to historical levels in October 2019. Dominion field investigations identified the likely source of the increased tritium concentrations to be surface water entering the east-west section of the pipe tunnel (also known as the Boron Recovery Tank Tunnel), running along the north side of the waste disposal building (Figure 3-5), infiltrating through the concrete of the pipe tunnel enclosure, and releasing residual tritium to the ground. The absence of radionuclides other than tritium in the GWP-18 sampling results, combined with the findings of field investigations, supports the conclusion that the elevated tritium concentrations were not caused by pipe leaks within the tunnel.

During 2020, remediation efforts related to GWP-18 tritium concentrations included sealing around external pipe tunnel entry areas to prevent potential surface and rain water runoff ingress (e.g., through personnel access portals, areas of concrete blocks). To date, sealing the tunnel has prevented the entry of surface water to maintain dry conditions within the tunnel, preventing any seepage through the tunnel structure to the ground (VEPCO 2021-TN8179). Subsequent to removal of the excess water from the pipe tunnel, concentrations at GWP-18 returned to historical levels that were consistently less than approximately 5,000 pCi/L. The 2020 improvements continue to maintain the pipe tunnel in a dry condition (VEPCO 2021-TN8179).

Based on flow patterns inferred from groundwater levels (Figure 3-5), tritium releases that may occur in potential source areas (e.g., Unit 1 water recovery storage tank, pipe tunnel) would be captured in the groundwater extracted by the mat sumps and discharged to a monitored nuclear power plant pathway. The mat sumps (see Figure 3-5 for locations of mat sumps) are designed to control water elevations around the Units 1 and 2 reactor buildings and the auxiliary building while maintaining groundwater elevations of approximately 240 ft above msl (VEPCO 2021-TN8268). Monitoring well water level observations outside of this area and north of the turbine building indicate that a groundwater flow pathway component toward Lake Anna exists; however, the lack of tritium detection in the monitoring wells within this area indicates that tritium in groundwater does not travel off the North Anna site along this pathway.

3.5.3 Proposed Action

3.5.3.1 Surface Water Resources

The following sections address the site-specific environmental impacts of North Anna SLR on the environmental issues identified in Table 3-1 that relate to surface water resources.

<u>Surface Water Use and Quality (Non-Cooling System Impacts)</u>

Surface water consumption for non-cooling water-related operational activities at North Anna is anticipated to be negligible and limited to uses such as facility and equipment cleaning. During the SLR term, surface water withdrawals from Lake Anna are not expected to change. As a result, no surface water use conflicts would be expected. No major refurbishment activities are proposed. Therefore, impacts due to the volume of water consumed from a surface water source during refurbishment activities would be insignificant when compared with that used or consumed by North Anna’s cooling system.

Aside from nuclear power plant operations, surface water withdrawals from Lake Anna are primarily non-consumptive in nature and are associated with recreational use. Dominion has not identified any proposed future surface water withdrawals that would affect the watershed of the reservoir (VEPCO 2020-TN8099). Withdrawals from and impoundments of surface waters within Virginia normally require a water protection permit. No water protection permit is required for any water withdrawal that was in existence on July 1, 1989. Because North Anna Units 1 and 2 have been in operation since before July 1, 1989, Dominion is exempt from needing a Virginia water protection permit for North Anna Unit 1 and 2 operations. Dominion does not plan to increase North Anna’s surface water withdrawals, and it would not be required to obtain a water protection permit unless there is an increase in withdrawals (NUREG-1437, Supplement 7, p. 3-30; NRC 2021-TN7294).

Wastewater from North Anna is discharged through VPDES-permitted outfalls. Stormwater discharges are also addressed in the VPDES permit (VEPCO 2022-TN8270). An underground fuel feed line to emergency and station blackout diesel generators leaked in 2016. The fuel lines were replaced in 2017 as part of the corrective action. A non-PCB mineral oil spill from a pad mounted transformer occurred in 2021 (VEPCO 2023-TN8534|Response to SWR-7 RCI|). This spill was remediated according to applicable regulations (VEPCO 2022-TN8270: SLR Application Supplement, p. E-4-47). On August 27, 2022, a 390-gal (1,476 L) oil spill involving a North Anna Unit 2 transformer occurred (VEPCO 2023-TN8534|Response to GEN-3 RAI|). The spill was contained within the berm around the transformer and did not migrate to Lake Anna. The spill was reported to VDEQ and remediation actions were taken. On February 20, 2023, approximately 354 gal (1,340 L) of aeration tank hydrostatic test water was discharged to Lake Anna in accordance with the Virginia General Permit. The tank water had a pH of approximately 9.9 and exceeded the permit limit range of 6.0 - 9.0. This exceedance was reported to VDEQ and the NRC. Dominion described that no resulting impacts to aquatic resources, groundwater resources, and human health have been reported (VEPCO 2023-TN8534|Response to GEN-3

RAI|). Refurbishment activities involving construction-related land disturbance would be managed under an approved SWPPP. North Anna maintains a spill prevention control and countermeasure (SPCC) plan that would further reduce the likelihood of impacts to surface waters from any liquid chemical spills (VEPCO 2022-TN8270: SLR Application Supplement, p. E-4-15). An underground fuel feed line to emergency and station blackout diesel generators leaked in 2016. The fuel lines were replaced in 2017 as part of the corrective action.

North Anna's surface water withdrawals are not expected to change. Compliance with current VPDES and stormwater regulatory requirements and permit conditions, and implementation of the SWPPP, SPCC plan, and BMPs, will result in continued minor impact to surface water and groundwater quality from non-cooling water systems. The NRC staff did not identify any new and significant information related to non-cooling water systems. The NRC staff concludes that the impact to surface water use and quality from non-cooling water systems during the North Anna SLR term would be SMALL.

Altered Current Patterns at Intake and Discharge Structures

During the SLR term, flow rates associated with cooling system intake and discharge have the potential to alter current patterns in a surface water body. The degree of the alterations depends on the characteristics of the surface water body, the design of the intake and discharge structures, and the flow rates.

Lake Anna is part of the cooling system for North Anna. The cooling water system draws water from Lake Anna and discharges it through a canal into the first of three lagoons of the WHTF. After cooling the in WHTF, water is released into Lake Anna through Dike 3 at the third WHTF lagoon (VEPCO 2020-TN8099: Section E3.6.1). The volume of Lake Anna is controlled by North Anna Dam. Releases from the North Anna Dam are regulated in accordance with the nuclear power plant's VPDES Permit No. VA0052451. Lake levels are controlled to target of 250 ft (76.2 m) above msl for the operation of the nuclear power plant (VEPCO 2020-TN8099: Section E3.6.1). Water released over the dam continues downstream to join with the South Anna River to form the Pamunkey River (VEPCO 2020-TN8099: Section E3.3.1).

For the proposed action, there are no modifications associated with the North Anna cooling system that would alter the existing current pattern. NRC staff finds that the existing current patterns are expected to remain the same during the proposed SLR operating term. The NRC staff did not identify any new and significant information related to cooling system and Lake Anna. The NRC staff concludes that the impacts of altered current patterns at intake and discharge would be SMALL during the proposed SLR term.

Altered Thermal Stratification of Lakes

Because cooling systems typically withdraw from the deeper, cooler portion of the water column of lakes or reservoirs and discharge to the surface, they have the ability to alter the thermal stratification of a surface water body with relatively stagnant waters (e.g., a lake). The heated discharge creates a thermal plume in the receiving water body and cools by losing heat to the atmosphere and to ambient water.

Dominion monitors temperature in Lake Anna at seven locations during the spring (generally March and May), late summer (August or September), and fall/winter (November or December). Temperature is measured at 1-m intervals, from the surface to the bottom of Lake Anna. Dominion reports that the long-term temperature data do not indicate an overall warming trend in the lake. Natural variability, which is common for most reservoirs the size of Lake Anna, does not demonstrate deleterious impacts from the nuclear power plant operation. The pattern of mixing and stratification, recorded between 2013 to 2021, have been reported to be within the natural seasonal patterns expected in Lake Anna (as lakes do not stratify year-round) (VEPCO 2022-TN8270: Supplement 1, Section E4.5.8.2). Dominion reports that long-term temperature data do not indicate an overall warming trend in the lake. Operations of North Anna have not appreciably changed the natural variability of Lake Anna water temperatures. The pattern of mixing and stratification, recorded between 2013 to 2021, have been reported to be within the natural seasonal patterns expected in Lake Anna (as lakes do not stratify year-round) (VEPCO 2022-TN8270: Supplement 1, Section E4.5.8.2).

The NRC staff finds that no modifications are planned to the North Anna cooling system for the proposed SLR operating term that would affect the existing seasonal stratification pattern. The NRC staff did not identify any new and significant information related to cooling system and Lake Anna. The NRC staff concludes that the impacts of thermal stratification of Lake Anna during the proposed SLR term would be SMALL.

Scouring Caused by Discharged Cooling Water

The high flow rate of water from a cooling system discharge structure has the potential to scour sediments and redeposit them elsewhere. The degree of scouring depends on the design of the discharge structure, the discharge flow rate, and the sediment characteristics. Scouring is expected to occur only in the vicinity of the discharge structures where flow rates may be high. While scouring is possible during reactor startup, operational periods would typically have negligible scouring.

North Anna’s cooling system draws water from Lake Anna and discharges it through a canal into the first of three lagoons of the WHTF (VEPCO 2022-TN8270: Section E4.5.7.2). Cooled water is released back into Lake Anna through Dike 3 at the third WHTF lagoon. The circulating water flow is the same during startup and normal operation (VEPCO 2022-TN8270: Supplement 1, Section E4.5.9.2).

There are no modifications planned to the North Anna cooling system for the proposed SLR operating term. The NRC staff did not identify any new and significant information related to cooling system and Lake Anna. The NRC staff concludes that the impacts from scouring caused by discharged cooling water during the proposed SLR term would be SMALL.

Discharge of Metals in Cooling System Effluent

Heavy metals such as copper, zinc, and chromium can be leached from condenser tubing and other components of the heat exchange system by circulating cooling water. These metals are normally addressed in NPDES permits because high concentrations of them can be toxic to aquatic organisms.

North Anna uses chemical additives approved by the VDEQ to control pH, scale, corrosion, and biofouling of various plant equipment (VEPCO 2022-TN8270: Supplement 1, Section E4.5.10.2). The current VPDES permit authorizes discharges from 10 external outfalls (seven industrial process wastewater and three stormwater) and 18 internal outfalls (16 industrial process wastewater and two stormwater). One of the internal outfalls (i.e., Outfall 105) is used for the bearing cooling tower blowdown. At this outfall, monitoring is required with limits for zinc and chromium and no detectable concentrations of the 126 priority pollutants present in chemical additives in the final effluent.

The VPDES limits the pH on all discharge outfalls to be between 6.0 - 9.0 standard units (VEPCO 2020-TN8099, Table E3.6.2). At the reported pH range of the effluent waters, the solubility of copper and iron is below 1.0 mg/L, and the solubility of zinc is approximately 10 mg/L (HEI 2022-TN8549). These lower solubility rates minimize metal dissolution and the chances of metals entering Lake Anna (VEPCO 2022-TN8270: Supplement 1, Section E4.5.10.2). Violations of permit limits must be reported to VDEQ and corrective actions must be taken.

The NRC staff finds that the regulatory controls and permits in place would mitigate impacts to surface waters from North Anna’s continued operations during the proposed SLR term. The NRC staff did not identify any new and significant information related to the cooling system and Lake Anna. The NRC staff concludes that compliance with current and future VPDES regulatory requirements, permit conditions, and BMPs will ensure that impacts from discharge of metals in North Anna’s cooling system effluents would be SMALL during the proposed SLR term.

Discharge of Biocides, Sanitary Wastes, and Minor Chemical Spills

The use of biocides and other water treatment chemicals is common and is required to control biofouling and nuisance organisms in plant cooling systems. However, the types of chemicals, their amounts or concentrations, and the frequency of their use may vary. Residual biocides used in cooling systems are discharged with cooling system effluents. Discharge of treated sanitary waste may occur via onsite wastewater treatment facilities, an onsite septic field, or connection to a municipal sewage system. Minor chemical spills collected in floor drains occur in industry. Each of these factors represents a potential impact on surface water quality.

North Anna uses commercially available water treatment chemicals, corrosion inhibitors, and algae inhibitors. Wastewater and stormwater discharges are regulated by the VPDES permit, which was administratively extended via a VDEQ correspondence dated April 3, 2019 (VEPCO 2023-TN8534|Response to SWR-1/AQ-2 RCI|). Dominion received a warning letter for a missed total suspended solids monitoring requirement at one of the outfalls (VEPCO 2022-TN8270: Supplement 1, Section E4.5.11.2). That monitoring was performed by Dominion at Outfall 103 (VEPCO 2023-TN8534|Response to WM-2/SWR-3 RCI|). However, the sample was not analyzed within the 7-day holding period. Because of this delay, the measurement of total suspended solids at Outfall 103 was invalid. In response, Dominion updated the sampling procedure ensure that (1) the isotopic analysis report is transmitted with the sample to avoid a potential delay in analysis, (2) laboratory reports are reviewed promptly, and (3) resampling is conducted if samples exceed the allowable holding time.

North Anna maintains an SPCC plan which would further reduce the likelihood of impacts to surface waters from any liquid chemical spills (VEPCO 2020-TN8099). An underground fuel feed line to emergency and station blackout diesel generators leaked in 2016. The fuel lines were replaced in 2017 as part of the corrective action. As described in *Surface Water Use and Quality (Non-Cooling System Impacts)* section above, two oil spills occurred in 2021 (VEPCO 2023-TN8534|Response to SWR-7 RCI|) and 2022 (VEPCO 2023-TN8534|Response to GEN-3 RAI|). The spills were remediated according to applicable regulations. Additionally, a 2023 discharge to Lake Anna in accordance with the Virginia General Permit that exceeded the permit limit range for pH, was reported to VDEQ and the NRC. Dominion described that the exceedance did not result in impacts to aquatic resources, groundwater resources, and human health (VEPCO 2023-TN8534|Response to GEN-3 RAI|).

The NRC staff did not identify any new and significant information related to use of biocides, disposal of sanitary wastes, and remediation of minor chemical spills. The NRC staff recognizes that North Anna's compliance with VPDES regulatory requirements and permit conditions and implementation of SWPPP, SPCC, and BMPs will minimize both the occurrence and size of spills and mitigate the impacts from discharges of biocides, sanitary wastes, and minor chemical spills. As a result, the NRC staff concludes that the impacts from discharges of biocides, sanitary wastes, and minor chemical spills at North Anna would be SMALL during the proposed SLR term.

Surface Water Use Conflicts (Plants with Once-Through Cooling Systems)

Nuclear power plant cooling systems may compete with other users relying on surface water resources, including downstream municipal, agricultural, or industrial users. As reported by Dieter et al. 2018 (TN8606), thermoelectric plant once-through cooling systems return most of their withdrawn water to the same surface water body, with evaporative losses of approximately 1 percent of the withdrawal amount. Consumptive use by plants with once-through cooling systems during the license renewal term is not expected to change unless power uprates, with associated increases in water use, are proposed.

As discussed in Section 3.5.1.2, North Anna's reported average surface water withdrawal rate between 2015 and 2022 was 1,865.7 mgd (7,062.4 mLd) (see Table 3-5). The 2021 average daily withdrawal, 1,855.6 mgd (7,024.1 mLd), represents about 11.4 percent of the conservation and active storage volume of Lake Anna (VEPCO 2022-TN8270: Supplement 1, Section E4.5.12.2). Lake Anna is not used as a drinking water source. There are no public water supplies within 5 miles of the outfalls. Aside from the nuclear power plant operations, surface water withdrawals from Lake Anna are primarily non-consumptive in nature and are associated with recreational use.

Withdrawals from and impoundments of surface waters within Virginia normally require a water protection permit. As mentioned in Section 3.5.1.2, as per 9 VAC 25-210-310, no water protection permit is required for any water withdrawal that was in existence on July 1, 1989 (TN8604). Because North Anna has been in operation since before July 1, 1989, Dominion is exempt from needing a Virginia water protection permit for North Anna Unit 1 and 2 operations (VEPCO 2022-TN8270: Supplement 1, Section E4.5.12.2). Moreover, Dominion does not plan to increase North Anna's surface water withdrawals, and it would not be required to obtain a water protection permit unless there is an increase in withdrawals.

Dominion requested change in its 2018 VPDES permit renewal application (VEPCO 2021-TN8268, currently under review by VDEQ) regarding control of releases from the North Anna Dam. These changes include installation of an automated means of making the releases (using a valve) required by the VPDES permit and inclusion of an orifice plate to maintain the minimum discharge required from the North Anna Dam, set by the Commonwealth of Virginia. The orifice maintains the minimum requirement of 40 cubic feet per second (cfs) (1.13 m^3/s) plus a 3 cfs (0.08 m^3/s) margin (i.e., a design discharge of 43 cfs [1.22 m^3/s]). Administratively, the VDEQ has continued the VPDES permit via a VDEQ correspondence dated April 3, 2019 (VEPCO 2023-TN8534|Response to SWR-1/AQ-2 RCI|).

No increase in North Anna's water withdrawal is planned during the SLR term. The NRC staff has not identified any proposed future surface water withdrawals that would affect the watershed of Lake Anna. NRC staff also recognizes that the VPDES permit dam release requirements mitigate water use impacts to downstream users and ecological communities. The NRC staff concludes that the impacts to surface water use from continued North Anna operations would be SMALL during the proposed SLR term.

<u>Effects of Dredging on Surface Water Quality</u>

Dredging in the vicinity of surface water intakes, canals, and discharge structures is undertaken by some nuclear power plant licensees to remove deposited sediment and maintain the function of plant cooling systems. Dredging also may be needed to maintain barge shipping lanes. Whether accomplished by mechanical, suction, or other methods, dredging disturbs sediments in the surface water body and affects surface water quality by temporarily increasing the turbidity of the water column. In areas affected by industries, dredging can also mobilize heavy metals, PCBs, or other contaminants in the sediments.

North Anna does not conduct maintenance dredging for Lake Anna, the WHTF, the intake area, or the discharge canal (VEPCO 2020-TN8099: Section E3.6.1.2.4; VEPCO 2022-TN8476: Section E4.5.13.1). Dominion does not anticipate performing dredging during the SLR term. Dredging activities conducted by others (e.g., private landowners) are small scale and occur in the upper fingers of Lake Anna for recreational purposes. The NRC staff found that Lake Anna dredging operations are brief in time and the effects are localized. The NRC staff also recognizes that these dredging operations are performed under permits issued by USACE and possibly State agencies (Section 3.5.1.3 above).

Because no maintenance dredging is currently conducted at North Anna and none is anticipated during the SLR term, the NRC staff concludes that impact of dredging on surface water quality would be SMALL during the proposed SLR term.

<u>Temperature Effects on Sediment Transport Capacity</u>

Increased temperature and the resulting decreased viscosity have been hypothesized to change the sediment transport capacity of water, leading to potential sedimentation problems, altered turbidity of rivers, and changes in riverbed configuration. In previous license renewal reviews, the NRC has not found temperature increase to significantly affect sediment characteristics. These alterations more likely result from the presence of structures or current patterns near intake and discharges.

Lake Anna is part of the cooling system for North Anna. The cooling water system draws water from Lake Anna and discharges it through a canal into the first of three lagoons of the WHTF. After cooling the in the WHTF, water is released into Lake Anna through Dike 3 at the third WHTF lagoon (VEPCO 2020-TN8099: Section E3.6.1). For the proposed action, there are no modifications associated with the North Anna cooling system that would alter the existing current pattern.

The NRC staff did not identify any new and significant information related to cooling system, Lake Anna sediment characteristics, or temperature effects on sediment transport. The NRC staff concludes that the impacts of temperature effects on sediment transport capacity would be SMALL during the proposed SLR term.

3.5.3.2 Groundwater Resources

The following sections address the site-specific environmental impacts of North Anna SLR on the environmental issues identified in Table 3-1 that relate to groundwater resources.

Groundwater Contamination and Use (Non-Cooling System Impacts)

Onsite groundwater use is discussed in Section E3.6.3.2 of Dominion's ER (VEPCO 2020-TN8099). Withdrawals from nuclear power plant dewatering operations and tritium plume control are much less than 100 gpm (378.5 lpm) and are unlikely to affect regional groundwater availability based on the hydrogeological setting of the site. During the license renewal term, Dominion will continue to operate the containment mat sumps around the Unit 1 and 2 reactor buildings and the auxiliary building at North Anna.

The NRC staff understands that North Anna continues to maintain and implement a site-specific SWPP and SPCC plan to prevent and reduce contamination to surface and groundwater. These plans identify and describe the procedures, materials, equipment, and facilities that are used to manage accidental spills (VEPCO 2020-TN8099).

NRC staff have not identified new and significant information during the audit, scoping process, or review of available information cited in this EIS. The NRC staff has concluded that, over the period of extended operation, potential groundwater contamination would likely remain onsite, and no offsite wells are expected be affected. North Anna has implemented a groundwater protection program to identify and monitor leaks through the installed monitoring well network and adheres to the appropriate state pollution prevention permits. With a robust sampling strategy, potential future releases of contamination into the groundwater would be readily detected. Dewatering systems are not expected to increase in discharge volume significantly, thereby an incremental effect on groundwater availability over that which has taken place is unlikely. Therefore, the NRC staff concludes that the non-cooling system impacts on groundwater contamination and use during the SLR term would be SMALL.

Groundwater Use Conflicts (plants that withdraw less than 100 gallons per minute [gpm])

The NRC staff understand that North Anna does not have planned modifications for the proposed SLR operating term that would significantly change groundwater withdrawal rates. Potential impacts of dewatering and tritium plume control are discussed above (Groundwater Contamination and Use (Non-cooling System Impacts)). Local and regional water consumption is discussed in Section 3.5.2.2 of this EIS.

In evaluating the potential impacts resulting from groundwater use conflicts associated with SLR, the NRC staff uses the existing groundwater resource conditions described in the "Water Resources - Groundwater" section of this site-specific EIS as its baseline. These baseline conditions encompass the existing hydrogeologic framework and conditions (including aquifers) potentially affected by continued operations, as well as the nature and magnitude of groundwater withdrawals as compared to relevant appropriation and permitting standards. The baseline also considers other potentially affected uses and users of the groundwater resources affected by the continued operation of the nuclear power plant. Future activities related to SLR at the North Anna site are not expected to require withdrawal of more than 100 gpm (378.5 lpm); nor are these activities expected to lower groundwater levels beyond the nuclear power plant boundary. Therefore, the NRC staff concludes that for this issue during the SLR term, impacts would be SMALL.

Radionuclides Released to Groundwater

The staff evaluated the potential contamination of groundwater from the release of radioactive liquids from nuclear power plant systems into the environment. Section 3.5.2.3 of this EIS contains a description of North Anna groundwater quality and radionuclides that North Anna has released into groundwater.

As discussed in Section 3.5.2.3, the NRC staff determined there has been no impact to the quality of offsite groundwater aquifers by past site activities at North Anna. Tritium contamination has been detected in the groundwater in a relatively small area near the Unit 1 reactor building. Monitoring well sampling results indicate that the tritium contamination is not moving offsite toward Lake Anna. Although tritium groundwater concentrations for some wells (PZ-3, GWP-3, GWP-6 and GWP-18; see Figure 3-5 for well locations) were above a Dominion threshold level of 5,000 pCi/L historically, monitoring well sampling concentrations from 2020 to 2022 have generally remained consistent with Lake Anna levels of less than approximately 5,000 pCi/L. All tritium groundwater concentrations have remained below the EPA-established drinking water maximum contaminant level of 20,000 pCi/L since 2014.

North Anna monitors groundwater for inadvertent releases as part of its groundwater protection program, which was implemented in 2007 under NEI 07-07, and in conjunction with the survey requirements of 10 CFR 20.1501 (TN283). The North Anna site has implemented a groundwater corrective action program as part of the GWPP to identify and stop leaks. Additionally, groundwater gradients due to dewatering of the power block basemat areas are monitored and, if needed, addressed to further reduce tritium migration. The monitoring well network and the GWPP sampling strategy are robust enough that potential future releases of tritium into the groundwater would likely be readily detected. Therefore, over the period of continued operations, there is little likelihood of significant impacts on the groundwater quality of onsite and offsite aquifers. Present and future operations at North Anna are not expected to impact the quality of groundwater in any aquifers that are current or potential future sources of water for offsite users. Therefore, the NRC staff concludes that the impacts on groundwater use and quality related to radionuclide release from continued operations would be SMALL.

3.5.4 No-Action Alternative

3.5.4.1 Surface Water Resources

Under the no-action alternative, surface water withdrawals would greatly decrease and eventually cease. Stormwater would continue to be discharged from the site, but wastewater discharges would be reduced considerably. As a result, shutdown would reduce the overall impacts on surface water use and quality with the reduction in pollutants discharged and thermal loading to receiving waters, including Lake Anna. Therefore, the impact of the no-action alternative on surface water resources would remain SMALL.

3.5.4.2 Groundwater Resources

With the cessation of operations, there should be a reduction in onsite groundwater consumption and little or no additional impacts on groundwater quality. Therefore, the NRC staff concludes that the impact of the no-action alternative on groundwater resources would be SMALL.

3.5.5 Replacement Power Alternatives: Common Impacts

3.5.5.1 Surface Water Resources

<u>Construction</u>

Construction activities associated with replacement power alternatives may cause temporary impacts on surface water quality by increasing sediment loading to water bodies and waterways. Construction activities also may affect surface water quality through pollutants in stormwater runoff from disturbed areas and excavations, spills and leaks from construction equipment, and from sediment and other pollutants disturbed by associated dredge and fill activities. These pollutants could be detrimental to downstream surface water quality, where applicable, and to ambient water quality in waterways near work sites.

Facility construction activities might alter surface water drainage features within the construction footprints of replacement power facilities, including any wetland areas. Potential hydrologic impacts would vary depending on the nature and acreage of land area disturbed and the intensity of excavation work.

The NRC staff assumes that construction contractors would implement BMPs for soil erosion and sediment control to minimize water quality impacts in accordance with applicable Federal, State, and local permitting requirements. These measures would include spill prevention and response procedures to avoid and respond to spills and leaks of fuels and other materials from construction equipment and activities.

For example, land clearing and related site construction activities would need to be conducted under a VDEQ-issued general VPDES permit for discharges from construction activities (VAR10) if more than 1 ac (0.4 ha) of land would be disturbed (9 VAC 25-880 Code of Virginia, TN8604). In accordance with the VPDES permit for discharges from construction activities, Dominion and its contractors would need to develop and implement a SWPPP that includes erosion and sediment controls, stormwater pollution prevention, and pollution prevention practices to prevent or minimize any surface water quality impacts during construction.

To the maximum extent possible, after any necessary modification, the existing North Anna surface water intake and discharge infrastructure would be used for replacement power components located on the North Anna site. This would reduce potential water quality impacts associated with the construction of new structures at the site.

Construction activities that would be conducted by Dominion and its contractors in and adjacent to waterways, wetlands, nearshore, and offshore areas would be subject to review and approval by applicable Federal and State regulatory agencies. For example, the discharge of dredged or fill material in waterways, at any stream crossings, and placement of structures in navigable waters would be subject to USACE permit provisions under CWA Section 404 and Section 10 of the Rivers and Harbors Appropriation Act of 1899 (TN660), respectively (33 CFR 322 and 323). Additionally, any potential impacts on tidal and nontidal wetlands and adjacent waters, as well as submerged lands, would be subject to regulation by VDEQ and the Virginia Marine Resources Commission (VIMS 2021-TN8484).

The NRC staff does not expect that any surface water would be diverted or withdrawn to support replacement power facility construction. It is more likely that, where necessary, water would be supplied by a temporary water tap from a municipal source and transported to the point of use or that onsite groundwater could be used (see Section 3.5.5.2, “Groundwater

Resources”). The likely use of ready-mix concrete also would reduce the need for onsite use of nearby water sources to support facility construction. Sanitary water use and wastewater generation would generally be limited to the construction workforce and would likely be accommodated through the use of portable restrooms.

Operation

The NRC staff assumes that thermoelectric power generating components of the replacement power alternatives would use closed-cycle cooling with mechanical draft cooling towers. Makeup water would be obtained from Lake Anna. Nuclear power plants using closed-cycle cooling systems with cooling towers withdraw substantially less water for condenser cooling than a thermoelectric power plant using a once-through system. However, the relative percentage of consumptive water use is greater in closed-cycle plants because of evaporative and drift losses during cooling tower operation (NRC 2013-TN2654). Surface water withdrawals would be subject to the Virginia Water Protection Permit Program (9 VAC 25–210, Code of Virginia, TN8604).

Closed-cycle cooling systems typically require chemical treatment such as biocide injections to control biofouling. Residual concentrations of these chemical additives would be present in the cooling tower blowdown discharged to receiving waters. However, chemical additions would be accounted for in the operation and permitting of liquid effluents. All effluent discharges from the thermoelectric power generation components would be subject to VPDES permit requirements for the discharge of wastewater and industrial stormwater to State waters. VPDES permit conditions require the permit holder to develop and implement a SWPPP and associated BMPs and procedures, which would help reduce surface water quality impacts during facility operation.

3.5.5.2 Groundwater Resources

Construction

Excavation dewatering for foundations and substructures during construction of replacement power generation facilities (e.g., SMR or SMR combined with solar photovoltaic and offshore wind power, including demand-side management, as applicable), may be required to stabilize slopes and permit placement of foundations and substructures below the water table. Groundwater levels in the immediate area surrounding an excavation may be affected, depending on the hydrogeologic conditions of the site, the duration of dewatering, and the methods (e.g., cofferdams, sheet piling, sumps, dewatering wells) employed for dewatering. Localized changes also could include altered groundwater flow directions, altered recharge or discharge rates, and groundwater discharge to wetlands. However, the NRC staff expects that any impacts on groundwater flow and quality affected by dewatering would be highly localized, of short duration, with minor effects on other groundwater users. Discharges resulting from dewatering operations would be released in accordance with applicable State and local permits as described above.

Although foundations, substructures, and backfill may alter local groundwater flow patterns, regional trends would remain unaffected. Construction of replacement power generating facilities may contribute to localized changes in groundwater infiltration and quality due to removal of vegetation and construction of buildings, parking lots, and other impervious surfaces. These changes may result in increased runoff and subsurface pollutant infiltration or discharge to nearby water bodies. Application of BMPs and implementation of an SWPPP would prevent or minimize any areawide groundwater quality impacts during construction.

In addition to construction dewatering, onsite groundwater could be used to support construction activities (e.g., dust abatement, soil compaction, water for concrete batch plants). Groundwater withdrawal during construction would have a temporary impact on local water tables or groundwater flow, and these withdrawals and resulting discharges would be subject to applicable permitting requirements.

Operation

Dewatering for building foundations and substructures may be required during the operational life of the replacement power facility. Operational dewatering rates would likely be lower than those rates required for construction and be managed subject to applicable permitting requirements. Dewatering discharges and treatment would be properly managed in accordance with applicable NPDES permitting requirements.

Groundwater may be used during operations for various nuclear power plant purposes, including general service water, fire protection, demineralized water makeup, and potable and sanitary needs. Water for these and other uses could be obtained from onsite groundwater wells or from a local water supply utility. The operational effects of groundwater use would be similar to those described for construction, with the principal difference being that the duration of pumping for operations would be significantly longer. Any onsite groundwater withdrawals would be subject to applicable State water appropriation and registration requirements.

Effluent discharges (e.g., cooling water, sanitary wastewater, and stormwater) from a facility are subject to applicable Federal, State, and other permits specifying discharge standards and monitoring requirements. Adherence by replacement power facility operators to proper procedures during all material, chemical, and waste handling and conveyance activities would reduce the potential for any releases to the environment, including releases to soil and groundwater.

For replacement power alternatives, the NRC staff assumes that some portion of potable water and water needed for various nuclear power plant systems would be obtained from onsite groundwater wells during operations. Any groundwater withdrawals would be subject to applicable State water appropriation, permitting, and registration requirements.

In summary, the NRC staff concludes that the common impacts of the replacement power alternatives on groundwater resources would be SMALL.

3.5.6 New Nuclear (Small Modular Reactor) Alternative

3.5.6.1 Surface Water Resources

The hydrologic and water quality assumptions and implications for construction and operations described in Section 3.5.5.1 as common to all replacement power alternatives also apply to this alternative. Additionally, deep excavation work required to construct the nuclear island could require groundwater dewatering (see Section 3.5.5.2). Water pumped from excavations would be managed and discharged in accordance with VPDES requirements. As a result, the staff expects that dewatering would not impact surface water quality.

During operations of the SMR complex, the closed-cycle cooling system would withdraw approximately 63 mgd (238 mLd) of makeup water, with consumptive use of 44 mgd (167 mLd). This withdrawal would be a small fraction of the volume of water that North Anna currently withdraws from Lake Anna. In contrast, the total consumptive use associated with the SMR closed-cycle system would be approximately double that of North Anna's estimated consumptive water use (see Section 3.5.1.2). Nevertheless, this consumptive use would still represent only a small fraction of Lake Anna's active and conservation storage volume, consistent with current operations of Units 1 and 2. In addition, the smaller volume of cooling water (primarily cooling tower blowdown) returned to the WHTF would have a smaller thermal impact on receiving waters than the current once-through cooling system. Based on the above discussion, the NRC staff concludes that the impacts on surface water resources from construction and operations under the new nuclear alternative would be SMALL.

3.5.6.2 Groundwater Resources

The NRC staff did not identify any impacts on groundwater resources for this alternative beyond those discussed above as common to all replacement power alternatives. Therefore, the NRC staff concludes that the impacts on groundwater resources from construction and operation of a new SMR nuclear power plant complex would be SMALL.

3.5.7 Combination Alternative (Solar, Offshore Wind, Small Modular Reactor, and Demand-Side Management)

3.5.7.1 Surface Water Resources

The hydrologic and water quality assumptions and implications for construction and operations described in Section 3.5.5.1 as common to all replacement power alternatives also apply to this alternative, except as clarified below.

For the new nuclear component, the operational impacts on surface water resources would be less than those described in Section 3.5.6.1 for the standalone new nuclear alternative. This is because the SMR complex would be smaller with significantly reduced water demands for cooling system makeup and consumptive water use (reduced by about 80 percent). Likewise, the discharge of effluents and cooling tower blowdown would be proportionately reduced.

Utility-scale solar photovoltaic installations would require the construction of pad sites, access roads, and possibly transmission lines or substation improvements (i.e., for sites with no current access to transmission lines or sufficient substation infrastructure) with the potential for alteration of surface water drainages at numerous sites across Dominion's service area and totaling 20,000 ac (8,000 ha). As discussed in Section 3.5.5.1, the NRC staff expects that all such construction activities would be conducted in accordance with applicable permits and approvals requiring the implementation of BMPs and procedures to minimize hydrologic and water quality impacts. Completed solar photovoltaic installations would have little to no operational impacts on water resources.

Construction of offshore WTG facilities, including support infrastructure, would disturb and erode marine sediments and temporarily deteriorate water quality in the marine environment over an area of some 6,800 ac (2,800 ha) during pile driving, the laying of cable, and the positioning of construction vessels and vessel anchors. The potential also exists for the discharge of petroleum, oil, and lubricants to marine waters from construction equipment and vessels (BOEM 2015-TN8399). The NRC staff expects that all marine construction activities would be conducted in accordance with applicable regulations governing erosion control, oil spill prevention and response (i.e., 40 CFR 110-TN8485 and 40 CFR Part 112-TN1041), and marine trash and debris plans and procedures, including U.S. Coast Guard pollution prevention requirements for at-sea discharges (BOEM 2015-TN8399). Excavation work to emplace submarine cabling to interconnect the WTG installations and to connect the WTGs with onshore electric transmission infrastructure would result in additional land and seafloor disturbance.

Once constructed, the area surrounding each WTG installation would be protected from further erosion, scour, and current action by a pad of rock armor, 3 to 6 ft (1 to 2 m) thick and covering an area of about 1 ac (0.4 ha) around each installation. The WTG facilities would likely result in alteration of water currents, but the changes would be localized. To minimize the potential for operational water quality impacts, the NRC staff presumes that each WTG installation would be designed with built-in spill containment to retain any spills of oil or cooling fluids (BOEM 2015-TN8399).

During operation and routine maintenance of utility-scale solar plants, relatively small volumes of water would be used to clean solar photovoltaic panels and possibly for operation and maintenance of panel pad sites and access roads.

Operation of WTG installations would be unlikely to have any impacts on marine waters as the turbines are self-contained and do not produce discharges during normal operations (BOEM 2018-TN8428).

Adherence to appropriate waste management and minimization plans, spill prevention practices, and pollution prevention plans during servicing of solar photovoltaic arrays and offshore WTG installations and operation of vehicles connected with site operations would minimize the risks to surface water resources from spills of petroleum, oil, and lubricant products and facility stormwater runoff.

Based on this analysis, the NRC staff concludes the overall impacts on surface water resources from construction and operation under the combination alternative could range from SMALL to MODERATE.

3.5.7.2 Groundwater Resources

The NRC staff did not identify any impacts on groundwater resources for this alternative beyond those discussed above as common to all replacement power alternatives. Therefore, the NRC staff concludes that the impacts on groundwater resources from construction and operation of a combination alternative nuclear power plant complex would be SMALL.

3.6 Terrestrial Resources

This section describes the terrestrial resources of the North Anna site and the surrounding landscape. Following this description, the staff analyzes potential impacts on terrestrial resources from the proposed action (SLR) and alternatives to the proposed action.

3.6.1 Ecoregion

The North Anna site lies in the Piedmont ecoregion (VEPCO 2020-TN8099). The EPA characterizes this ecoregion (Level III Ecoregion 45) as largely wooded with irregular plains, low rounded hills and ridges, shallow valleys, and scattered monadnocks. The Piedmont is a transitional ecoregion sandwiched between mountainous Appalachian ecoregions to the west and more level coastal ecoregions to the east (EPA 2013-TN5033). The forest cover was once dominated by Oak-Hickory-Pine forest, but widespread settlement of this portion of northeastern Virginia since the colonial era resulted in forest and soil loss. There are no longer virgin forests, but today, many formerly cultivated lands in the Piedmont ecoregion have reverted to successional pine and hardwood forests (NRC 2006-TN8385: Section 2.7.1).

The Piedmont ecoregion consists of four subregions, two of which are most relevant to North Anna: (1) the northern inner Piedmont subregion, which contains two arms of Lake Anna, and (2) the northern outer Piedmont subregion, which contains the North Anna site. Dominion's description of these two subregions is incorporated here by reference (VEPCO 2020-TN8099: p. E-3-143 to E-3-144).

Dominion's ER (VEPCO 2020-TN8099) includes descriptions of several regional ecosystems in the landscape near the North Anna site, including:

- Piedmont Central Appalachian Mixed Oak/Hardwood Forest Natural Community
- Coastal Plain/Outer Piedmont Acidic Seepage Swamp

The descriptions, presented in Dominion's ER (VEPCO 2020-TN8099: p. E-3-150 through E-3-151) characterize the tree canopy, shrub, and herbaceous strata of each plant community relying on information from the Virginia Department of Conservation and Recreation and are incorporated here by reference.

Wetlands are common features in the landscape surrounding the North Anna site. Wetlands are defined by USACE as areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (33 CFR 328.3(c)(4); 33 CFR Part 328-TN1683).

Using the U.S. Fish and Wildlife National (FWS) Wetlands Inventory, Dominion mapped and estimated there are approximately 19,000 ac (7689 ha) of wetlands within a 6-mi (9.7-km) radius of the North Anna site (VEPCO 2020-TN8099). These include the following:

- freshwater emergent wetlands – 180 ac (73 ha)
- freshwater forested/scrub shrub wetlands – 2,500 ac (1,012 ha)
- freshwater pond – 200 ac (81 ha)
- lake covering – 13,000 ac (5,261 ha)
- riverine covering – 3,000 ac (1,214 ha)

3.6.2 North Anna Site

The North Anna site consists of a peninsula of land jutting into Lake Anna, which partially surrounds the site to the east, north, and southeast. The open water of Lake Anna comprises approximately 34 percent of the site, approximately 37 percent of the site is forest, and approximately 16 percent is developed. The remaining 13 percent of the site consists of barren land, shrub/scrub, grassland/herbaceous, pasture/hay, cultivated crops, and wetlands (VEPCO 2020-TN8099). Of the terrestrial portion of the site, approximately 30 percent is developed, consisting of power generation and maintenance facilities, administrative buildings, parking lots, roads, mowed grass, and other cleared areas (VEPCO 2020-TN8099). The remainder of the site lands that have not been cleared and developed mainly consist of hardwood forests and planted pines dominated by a variety of oaks (*Quercus* spp.), yellow poplar (*Liriodendron tulipifera*), sweet gum (*Liquidambar styraciflua)*, and red maple *(Acer rubrum*) trees, as well as scattered pines such as loblolly pines (*Pinus taeda*), Virginia pines (*P. virginiana*), and shortleaf pines (*P. echinata*) (NRC 2006-TN8385: Section 2.7.1.1). There are also small areas of shrub/scrub, woody wetlands, and grassland/herbaceous land.

North Anna site boundaries include a total of 650 ac (263 ha) of wetland, lake, and riverine waters. Most of the water and wetland acreage is occupied by Lake Anna, with 630 ac (255 ha) inside the North Anna site (VEPCO 2020-TN8099). Table 3-6 identifies wetlands and surface water features on the North Anna site.

Table 3-6 Wetlands and Surface Water Features on North Anna Power Plant Site

Wetland or Water Feature	Area	Percent of Onsite Wetland Habitat
Lake	630 (255 ha)	97
Freshwater pond covering	16 ac (6.5 ha)	2.4
Freshwater/forested wetlands	5.6 ac (2.3 ha)	0.9
Riverine covering	1.3 ac (0.5 ha)	0.2

Note: ac = acre; ha = hectares.

Figure E3.7-2 of the ER (VEPCO 2020-TN8099: p. E-3-188) shows the location of National Wetland Inventory wetlands on the North Anna site and is incorporated here by reference.

The wildlife species occurring in the forested portions of the North Anna site are typical of the wildlife species found in the upland Piedmont forests of northeastern Virginia. Frequently observed mammals in the upland Piedmont forests include the white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), gray squirrel (*Sciurus carolinensis*), and gray fox (*Urocyon cinereoagenteus*). These species all also exist on the North Anna site. Smaller mammals such as moles (*Talpidae*), shrews (*Soricidae*), and a variety of mice (*Muridae*) and voles (*Microtus spp.*) are also common on the forested portions of the North Anna site. Groundhogs (*Marmota monax*) live in the grassy areas near forest edges at the site, and beavers (*Castor canadensis*) occur in Lake Anna and its tributaries. Various birds and herpifauna (e.g., snakes, turtles, lizards, and toads) live in the uplands and along the edge of Lake Anna (NRC 2006-TN8385). In Table E3.73 of its ER, Dominion (VEPCO 2020-TN8099: p. E-3-174 through E-3-184) presents a list of terrestrial wildlife species likely to be observed within a 6-mi (10-km) radius of the North Anna site. This list of amphibian, bird, insect, mammal, and reptile species is sourced from the Virginia Department of Game and Inland Fisheries (VDGIF)[2] Fish and Wildlife Information System (FWIS), as accessed in March 2020, and is incorporated here by reference. Dominion does not indicate that any of the species in the table are unusual for the region.

Several species of residential and migratory wading birds and waterfowl use Lake Anna. Great blue herons (*Ardea herodias*) and belted kingfishers (*Ceryle alcyon*) are present at Lake Anna throughout the year. Mallards (*Anas platyrhynchos*), wood ducks (*Aix sponsa*), and Canada geese (*Branta canadensis*) breed at Lake Anna. Dominion notes that Lake Anna provides important habitat for migratory waterfowl on the Atlantic Flyway, a major route for migratory birds during the fall and spring (VEPCO 2020-TN8099). Especially during very cold winters, elevated water temperature from North Anna station operations helps maintain a large ice-free

[2] As of July 1, 2020, the VDGIF was renamed and is now known as the Virginia Department of Wildlife Resources (VDWR). References to VDGIF in this document include the VDWR.

body of water (NRC 2006-TN8385: Section 2.7.1.1). Forests, wetlands, and other natural habitats within flyways can help facilitate the seasonal migration of large numbers of birds over long distances separating wintering areas from summer breeding areas.

3.6.3 Important Species and Habitats

3.6.3.1 Federally Listed Species

For a discussion of terrestrial species and habitats that are federally protected under the Endangered Species Act of 1973, as amended, see Section 3.8, "Special Status Species and Habitats," in this report.

3.6.3.2 State-Listed Species

Based on a review of VDGIF and Virginia Natural Heritage Program databases, Dominion identified nine State-listed species known to occur or potentially occur in Louisa or Spotsylvania counties (VEPCO 2020-TN8099). Of these nine State-listed species, six are terrestrial and three are aquatic. The table of Federal and State-listed species provided by Dominion (2020-TN8099: p. E-3-186) in Table E3.7-5 of its ER is incorporated here by reference. Four of the State-listed species also are federally listed. As explained above, the NRC staff will address the four State-listed species that are also federally listed in Section 3.8 of this EIS. Table 3-7 below shows State-listed species for Louisa and Spotsylvania counties that are not also federally listed. The descriptions of the following State-listed species in Dominion's ER (VEPCO 2020-TN8099: p. E-3-165 through E-3-167) are incorporated here by reference.

Table 3-7 State-Listed Species for Louisa and Spotsylvania Counties, VA, Potentially Occurring in the North Anna Vicinity (That Are Not Federally Listed)

Common Name	Scientific Name	Class	State Legal Status
Little brown bat	*Myotis lucifugus*	mammal	State Endangered
Rafinesque's eastern big-eared bat	*Corynorhinus rafinesquii macrotis*	mammal	State Endangered
Tricolored bat	*Perimyotis subflavus*	mammal	State Endangered
Loggerhead shrike	*Lanius ludovicianus*	bird	State Threatened
Virginia Piedmont water boatman	*Sigara depressa*	heteropteran (true bugs)	State Endangered

Of the five State-listed species above, three are endangered bats. Two of these bats, the little brown bat and the tricolored bat, were once abundant, but their numbers have declined sharply due to white-nose syndrome (a fungal disease) and possible environmental toxin exposures such as from herbicides and pesticides (VEPCO 2020-TN8099). The third bat, Rafinesque's big-eared bat, is adapted to temperate arboreal zones of extreme southeast Virginia so is less likely to occur near the North Anna site.

A March 2020 review of the VDGIF FWIS species observation yielded no observation of any of these three State-listed bats within 6 mi (10 km) of North Anna. However, two of the bats—the little brown bat and tricolored bat—were spotted 50 mi (80 km) away from North Anna. In 2016, Dominion contracted a bat survey for the forested portions of the site where proposed North Anna Unit 3 might be located (VEPCO 2020-TN8099). Contractors used mist-net surveys and captured a total of 29 bats in 84 nights. None of the captured bats were federally or State-listed bat species. Although recent surveys have not observed little brown bats and tricolored bats in the North Anna area, it is still possible that they occur there. The little brown bat roosts in both human-made structures and trees, and the tricolored bat may roost in both buildings and trees near water. Such conditions are readily available on the terrestrial portion of the North Anna site (VEPCO 2020-TN8099). If present at the North Anna site, these bats could forage in the forested areas of oaks, yellow popular, sweet gum, red maple, and occasional loblolly pines and Virginia pines and nest in trees or in human-made structures.

The State-listed threatened bird, the loggerhead shrike, is tolerant of some disturbed habitat but is unlikely to visit developed areas of an active power generation facility. It also is protected under the Migratory Bird Treaty Act (16 U.S.C. 703 et seq.; TN3331). A March 2020 review of VDGIF FWIS species yielded one possible observation of the loggerhead shrike in Mineral, Virginia, which at 7 mi (11 km) southwest, is the nearest town to North Anna (VEPCO 2020-TN8099).

The State-listed endangered insect, the Virginia Piedmont water boatman, is a poorly characterized species. It is also federally identified as a species of concern. This insect is only known to inhabit four sites, all small streams in Virginia's Piedmont province. None of these streams is in Louisa County or Spotsylvania County, the two counties surrounding North Anna, so the Virginia Piedmont water boatman is less likely to be present at or near the North Anna site. As expected, a March 2020 review of VDGIF FWIS species yielded no observation of the Virginia Piedmont water boatman within 6 mi (10 km) of North Anna.

3.6.3.3 Species Protected under the Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (16 U.S.C. §§ 668-668c; TN1447) extends regulatory protections to the bald eagle and golden eagle. The Act prohibits anyone without a permit from the Secretary of the Interior from "taking" bald eagles (or golden eagles), including their parts, nests, or eggs. According to Dominion (VEPCO 2020-TN8099). there are four known bald eagle nests adjacent to Lake Anna, and one of these is located on the North Anna site. The Center for Conservation Biology at the College of William and Mary conducts annual surveys for eagle and osprey nests and makes the data publicly available on an online mapping tool. The Center's mapping portal confirms four bald eagle nests adjacent to Lake Anna as of 2018 (CCB 2018-TN9075). According to Dominion (VEPCO 2020-TN8099). all four nests were occupied and produced young in 2019.

3.6.3.4 Species Protected under the Migratory Bird Treaty Act

The Migratory Bird Treaty Act makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued pursuant to Federal Regulations. Dominion has an internal guidance document for compliance with the Migratory Bird Treaty Act. Dominion maintains an annual depredation permit from the FWS for Dominion-owned properties in Maryland, Virginia, West Virginia, and North Carolina that authorizes it to take a maximum of 70 black vultures, 20 turkey vultures, 40 Canada geese, and 25 herring gulls. In addition, Dominion's annual depredation permit allows destruction of nests and eggs of 10 herring gull nests and 5 osprey nests (VEPCO 2020-TN8099).

3.6.3.5 Invasive Species

Invasive species are defined as a non-native organism whose introduction causes or is likely to cause economic or environmental harm, or harm to human, animal, or plant health (EO 13751:

Section 2(e)); 81 FR 88609-TN8375). Executive Order (EO) 13112 (64 FR 6183-TN4477) directs Federal agencies to not authorize, fund, or carry out actions likely to cause or promote the introduction or spread of invasive species unless they determine that the benefits of the action clearly outweigh the harm from invasive species and that all feasible and prudent measures to minimize risk of harm are taken (EO 13112: Section 2; TN4477). Dominion maintains guidance documents with policies and procedures for invasive species management at North Anna (VEPCO 2020-TN8099). Dominion identified the following as important invasive terrestrial plant and animal species:

- Invasive Terrestrial Plant Species: kudzu (*Pueraria montana*), autumn olive (*Elaeagnus umbellata*), and tree-of-heaven (*Ailanthus altissima*)
- Invasive Terrestrial Animal Species: emerald ash borer (*Agrilus planipennis*), rock dove or pigeon (*Columba livia*), and European starling (*Sturnus vulgaris)*

Descriptions of the above-listed invasive species are incorporated here by reference (VEPCO 2020-TN8099: p. E-3-154 to E-3-156).

3.6.3.6 Important Habitats

Important habitats include any wildlife sanctuaries, refuges, preserves, or habitats identified by State or Federal agencies as unique, rare, or of priority for protection; wetlands and floodplains; and land areas identified as critical habitat for species listed by FWS as threatened or endangered. Important habitats on and around the North Anna site include the wetlands discussed above in Section 3.6.1 and Section 3.6.2. In particular, Lake Anna provides important habitat for migratory waterfowl on the Atlantic Flyway, especially during very cold winters when heat released by station operations maintains an ice-free body of water (NRC 2006-TN8385).

3.6.4 Proposed Action

The following sections address the site-specific environmental impacts of North Anna SLR on the environmental issues identified in Table 3-1 that relate to terrestrial resources.

3.6.4.1 Effects on Terrestrial Resources (Non-Cooling System Impacts)

According to the LR GEIS, non-cooling system impacts on terrestrial resources can include those impacts that result from site and landscape maintenance activities, stormwater management, elevated noise levels, and other ongoing operations and maintenance activities that would occur during the license renewal period on and near a nuclear power plant site. The NRC staff based its analysis in this section on information derived from Dominion’s ER (VEPCO 2020-TN8099) unless otherwise cited. Dominion has not identified any refurbishment activities during the proposed subsequent relicensing term (VEPCO 2020-TN8099). No further analysis of potential impacts from refurbishment activities is therefore necessary.

In its ER, Dominion (VEPCO 2020-TN8099) states that it will conduct ongoing operational and maintenance activities at the North Anna site throughout the SLR term, including landscape maintenance activities, stormwater management, piping installation, and fencing. Dominion states that it would confine these activities to previously disturbed areas. The NRC staff expects that physical disturbance would be limited to paved or disturbed areas or to areas of mowed grass or early successional vegetation and not encroach into wetlands or into the remaining areas of mixed pine-hardwood forest. The NRC staff concurs with Dominion that the anticipated activities would have only minimal effects on terrestrial resources.

Dominion (VEPCO 2020-TN8099) states that it has administrative controls in place at the North Anna site to ensure that it reviews operational changes or construction activities and minimizes environmental impacts through BMPs, permit modifications, or new permits, as needed. Dominion further states that regulatory programs for issues like stormwater management, spill prevention, dredging, and herbicides further minimize impacts on terrestrial resources (VEPCO 2020-TN8099). The NRC staff concurs that continued adherence to environmental management practices and BMPs already established for the North Anna site would continue to protect terrestrial resources during the SLR operational period.

The NRC staff presumes that Dominion will continue to comply with applicable requirements of the Commonwealth of Virginia's regulatory programs. Furthermore, the staff presumes that if appropriate, Dominion will obtain required incidental take permits for impacts on bald eagles.

Operational noise from North Anna facilities extends into the remaining natural areas on the site. However, North Anna has exposed these habitats to similar operational noise levels since construction activities commenced more than 50 years ago. The NRC staff therefore expects that wildlife in the affected habitats have long ago acclimated to the noise and human activity of North Anna operations and adjusted their behavior patterns accordingly. Extending the same level of operational noise levels over the 20-year SLR period is therefore unlikely to noticeably change the patterns of wildlife movement and habitat use.

Based on its independent review, the NRC staff concludes that the landscape maintenance activities, stormwater management, elevated noise levels, and other ongoing operations and maintenance activities that Dominion might undertake during the renewal term would primarily be confined to already disturbed areas of the North Anna site. These activities would neither have noticeable effects on terrestrial resources nor would they destabilize any important attribute of the terrestrial resources on or in the vicinity of the North Anna site. Accordingly, the NRC staff concludes that non-cooling system impacts on terrestrial resources from non-cooling system activities during the subsequent relicensing term would be SMALL.

3.6.4.2 Exposure of Terrestrial Organisms to Radionuclides

This issue concerns the potential impacts on terrestrial organisms from exposure to radionuclides from routine radiological effluent releases. Radionuclides may be released from nuclear power plants into the environment through gaseous emissions and liquid effluents. Terrestrial plants can absorb radionuclides that enter shallow groundwater or surface waters through their roots. Animals may experience exposure to ionizing radiation through direct contact with air, water, or other media; inhalation; or ingestion of contaminated food, water, or soil.

In the 2013 LR GEIS, the NRC estimated the total radiological dose that four non-human receptors; riparian animal, terrestrial animal, terrestrial plant, and aquatic animal would be expected to receive during normal nuclear power plant operations based on plant-specific radionuclide concentrations in water, sediment, and soils at 15 operating nuclear power plants. The NRC found that total calculated dose rates for all terrestrial receptors at all 15 plants were significantly less than the DOE guideline values. As a result, the NRC anticipated in the 2013 LR GEIS that normal operations of these facilities would not result in negative effects on terrestrial biota. The 2013 LR GEIS concluded that the impact of radionuclides on terrestrial biota from past operations would be SMALL for all nuclear plants and would not be expected to change appreciably during the initial license renewal period. Below, the NRC staff analyzes this issue site-specifically for the SLR term, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN8272).

In reviewing Dominion's ER (VEPCO 2020-TN8099) and supplemental environmental information (VEPCO 2021-TN8524) as well as RAI responses (VEPCO 2023-TN8534), there have been no new unplanned radionuclide releases to the environment. Operations for North Anna are proposed to continue using current environmental monitoring for radiation and radioactive materials, to include potential exposure pathways in the environment. Air, soil, and vegetation samples are collected regularly for detection of radionuclides and terrestrial exposure pathway indicators such as milk and food products also are collected and assayed for radionuclides (VEPCO 2020-TN8099). Levels of radionuclides in the environmental samples are reported to be at background levels, or have been decreasing from preoperational phase fallout levels as reported in the ER (VEPCO 2020-TN8099).

Impacts to human health and the environment from radiological impacts are assessed using the same radiation protections, regulations, and requirements. NRC staff use the RESRAD-BIOTA dose model to determine estimated dose rates for terrestrial biota (DOE 2004-TN6460). The REMP reports for North Anna are below the Lower Limits of Detection and are discussed further in Section 3.10 of this document. Dominion has not identified any refurbishment activities during the license renewal period, and the potential for additional radiological releases is minimal.

During the SLR term, current operating conditions and environmental stressors would continue rather than wholly new impacts being introduced. Therefore, the impacts of current operations and SLR on terrestrial organisms' exposure to radionuclides would be similar. For these reasons, the effects of radionuclide exposure would be minor and would neither destabilize nor noticeably alter any important attribute of this resource during the SLR term. The NRC staff concludes that the impacts of exposure to radionuclides on terrestrial resources during the North Anna SLR term would be SMALL.

3.6.4.3 Cooling System Impacts on Terrestrial Resources (Plants with Once-Through Cooling Systems or Cooling Ponds)

Cooling system impacts on terrestrial resources at North Anna may result from thermal and chemical effects of once-through cooling discharge on waterfowl, and disturbance to wetland and riparian habitats through maintenance activities associated with cooling systems.

The 2013 LR GEIS (NRC 2013-TN2654) summarizes how many of these effects have only been identified at a small number of nuclear power plants, and these plants have modified plant operations to reduce or eliminate the effects. For instance, elevated concentrations of heavy metals such as copper can be discharged into the cooling systems from condenser tubing. At one plant, sublethal concentrations of copper affected the morphology and reproduction of resident bluegill (*Lepomis macrochirus*) (Harrison 1985-TN7579), and at another, abalone (*Haliotis* species) mortality was attributed to copper exposure in plant effluents (NRC 1996-TN288). Terrestrial wildlife that feed on these aquatic organisms could also have been exposed to elevated copper levels and could have experienced adverse effects. However, these nuclear power plants subsequently replaced the copper alloy condenser tubes with tubes made of different materials (e.g., titanium), which has eliminated these impacts. This issue has not been reported at any other nuclear power plants. Below, the NRC staff analyzes this issue site-specifically for the SLR term, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN8272).

Dominion reports no cooling discharge impacts resulting in violations of the North Anna VPDES permit relevant to temperature, water availability, and contaminants in the discharge to Lake

Anna (VEPCO 2020-TN8099). The proposed relicensing action would not result in changes to the current operational conditions for discharge of effluent.

Between 2013 and 2022, the recorded bird deaths and injuries at North Anna were not attributed to impingement on the intake screens (VEPCO 2020-TN8099, VEPCO 2022-TN8270). The intake screens are routinely maintained to remove biofouling which likely reduces the potential for avian foraging from organisms caught on the intake screens.

Wetland and riparian habitats at North Anna are managed by Dominion for conservation by using BMPs to protect streams from stormwater runoff and erosion. No wetlands or riparian habitats are present near the plant intake and discharge structures on Lake Anna. No maintenance dredging in Lake Anna occurs for plant operations, and none is expected during the SLR term (VEPCO 2022-TN8270).

Dominion has not identified any construction or change in cooling system operations during the license renewal period. Therefore, the impacts for continued operation cooling system operations of North Anna would be similar to current operation conditions, and the NRC staff concludes that the potential for cooling system impacts to terrestrial organisms during the North Anna SLR term with would SMALL.

3.6.4.4 Bird Collisions with Plant Structures and Transmission Lines

Bird collisions and potential for mortality are associated with tall structures such as cooling towers, transmission structures, meteorological towers, and other nuclear power plant infrastructure. Bird mortality is of concern if the resulting reduction in population numbers threatens the stability of the species or significantly impairs its function within the ecosystem. In the LR GEIS (NRC 2013-TN2654), the NRC staff found that the available data on bird collision mortality associated with nuclear power plant cooling towers and other structures suggest that the number of bird mortality collisions is small, and primarily occur during the spring and fall migration of songbirds at night. Below, the NRC staff analyzes this issue site-specifically for the SLR term, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN8272).

The tallest structures on the North Anna site are the containment buildings (191 ft [58.2 m]) and meteorological tower (160 ft [48.8 m]) (VEPCO 2020-TN8099). There are no cooling tower structures at North Anna. Dominion maintains an avian monitoring plan in cooperation with the FWS and State agencies to establish and evaluate monitoring protocols based on specific Dominion activities for impacts to migratory birds (VEPCO 2020-TN8099). Dominion reported 26 avian deaths between 2013 and April 2022 near North Anna structures and across the North Anna site (VEPCO 2022-TN8270). This low number over a 10-year span suggests avian mortality in general as low and does not have the potential to adversely affect bird populations.

Under the SLR, current operating conditions and environmental stressors would continue to exist, rather than introduce wholly new impacts. Therefore, the impacts of current operations and SLR on bird collisions would be similar. For these reasons, the effects of bird collisions with plant structures and transmission lines would be minor and would neither destabilize nor noticeably alter any important attribute of bird populations during the SLR term. The NRC staff concludes that the impacts of bird collisions with plant structures or transmission lines during the North Anna SLR term would be SMALL.

3.6.4.5 Transmission Line Right-of-Way Management Impacts on Terrestrial Resources

In the LR GEIS (2013-TN2654), the NRC staff found no significant impacts to terrestrial resources from vegetation management in transmission corridors. In general, utilities maintain transmission line ROWs by physical (mowing, cutting) and chemical (herbicides, pesticides) means. Equipment use and application of chemicals have the potential to alter the ecosystem by disruption and compaction of soils or runoff of chemicals to nearby sensitive habitats. ROW maintenance activities can therefore encourage growth of nuisance species or non-native species in what is typically lower quality habitat. Below, the NRC staff analyzes this issue site specifically for the SLR term, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN8272).

Dominion follows a vegetation management plan and maintains a three-year cycle of ROW corridor maintenance primarily with mowers, and in areas not accessible to mowers, by use of selective herbicides or hand-cutting where sensitive habitats are nearby such as wetlands. Dominion works with the VDCR Natural Heritage Division to identify and protect areas within transmission ROWs that have rare, threatened, and endangered plant species. These areas are flagged and specifications for management are described to avoid impacts to these species and habitats (VEPCO 2020-TN8099).

During the SLR term, Dominion will not be expanding or constructing new transmission or ROW corridors connecting the plant to the first substation. Dominion would continue to maintain onsite transmission line ROWs in accordance with North American Electric Reliability Corporation standards (VEPCO 2020-TN8099). The SLR would continue current operating conditions and environmental stressors rather than introduce wholly new impacts. Therefore, the impacts of current operations and SLR on transmission ROW maintenance impacts on terrestrial resources would be similar. For these reasons, the effects of transmission ROW maintenance impacts would be minor and would neither destabilize nor noticeably alter any important attribute of this resource during the SLR term. The NRC staff concludes that the impacts of transmission ROW maintenance on terrestrial resources during the North Anna SLR term would be SMALL.

3.6.4.6 Electromagnetic Fields on Flora and Fauna (Plants, Agricultural Crops, Honeybees, Wildlife, Livestock)

In the LR GEIS (2013-TN2654), the NRC staff found the potential for adverse electromagnetic field (EMF) exposure to terrestrial resources is negligible for the plant site and connection to the first substation during the license renewal term. The generation of EMF from operating transmission lines is generally stronger from higher voltage lines greater than 345 kV, although there have been no studies that have reported significant ecological impacts from EMF generated by transmission lines operating at up to 1,100 kV, with the potential exception of honeybees in hives under transmission lines. Below, the NRC staff analyzes this issue site specifically for the SLR term, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN8272).

At North Anna, the in-scope transmission lines do not cross agricultural or native wildlife habitats, and the highest voltage is 500 kV (VEPCO 2022-TN8270). The potential for EMF impacts on terrestrial resources is therefore not likely to be noticeable, and terrestrial plant and animals in the vicinity of operating transmission lines are habituated to any EMF exposure.

During the SLR term, current operating conditions and environmental stressors would continue rather than introduce wholly new impacts. Therefore, the impacts of current operations and SLR on EMF impacts on terrestrial resources would be similar. For these reasons, the effects of EMF impacts would be minor and would neither destabilize nor noticeably alter any important attribute of this resource during the SLR term. The NRC staff concludes that the impacts of EMF on terrestrial resources during the North Anna SLR term would be SMALL.

3.6.5 No-Action Alternative

Under the no-action alternative, the NRC would not issue a renewed license, and North Anna would shut down on or before the expiration of the current facility operating licenses. Much of the operational noise and human activity at North Anna would cease, reducing disturbance to wildlife in forest cover and other natural vegetation on and near the site. However, some continued maintenance of the North Anna site would still be necessary; thus, at least some human activity, noise, and herbicide application would continue at the site, with possible impacts resembling, but perhaps of a lower magnitude than those described for the proposed action. Shutdown itself is unlikely to noticeably alter terrestrial resources. Reduced human activity and frequency of operational noise may constitute minor beneficial effects on wildlife inhabiting nearby natural habitats. The NRC staff therefore concludes that the impacts of the no-action alternative on terrestrial resources would be SMALL.

3.6.6 Replacement Power Alternatives: Common Impacts

The NRC staff assumes that each of the replacement power alternatives located onsite at North Anna would use the mixed developed and forested land licensed by the NRC ESP for construction of the proposed North Anna Unit 3. Under the ESP for Unit 3, there would be a permanent loss of up to 120 ac (49 ha) of forest, as well as 0.31 ac (0.13 ha) of nontidal wetlands and 752 ft (229 m) of ephemeral streams (VEPCO 2020-TN8099). An additional maximum of 90 ac (36 ha) of land would be temporarily disturbed for construction and laydown areas but later revegetated (NRC 2010-TN6). Either replacement power alternative would result in forest and wetland loss. In either case, destruction of the forest cover would reduce the availability of habitat for forest-interior birds and terrestrial plants and animals occurring on the site.

Removing forest cover on the North Anna site would involve the loss of wildlife habitat and reduce the available forest capable of buffering other nearby wildlife habitats from operational noise and human activity. Loss of habitat and increased noise generation during construction and operation of the new facilities could cause terrestrial wildlife to move into new habitats in the surrounding landscape, increasing demands on those habitats and competing with other wildlife. Erosion and sedimentation from clearing, leveling, and excavating land could affect adjacent riparian and wetland habitats, but implementation of appropriate BMPs and revegetation of temporarily disturbed lands would minimize impacts. For any of the replacement power alternatives, the NRC staff also expects that Dominion would obtain any required incidental take permits for impacts on bald eagles.

Comparing the reactor-related elements of the two replacement power alternatives, the effects of operations on terrestrial resources at the ESP North Anna Unit 3 site would be similar but would vary in intensity. Both alternatives include SMRs. However, the five-SMR alternative would require more land cleared and therefore have a greater impact on terrestrial resources at the ESP North Anna Unit 3 site than the one-SMR alternative. Both facilities include tall mechanical draft cooling towers that could result in a similar number of bird and bat collisions. In addition, both facilities would use existing North Anna transmission lines, so terrestrial impacts from transmission line structures and maintenance would be unchanged from the impacts of current North Anna 1 and 2 operations. The LR GEIS (NRC 2013-TN2654) considered terrestrial impacts from operation of nuclear power plants from cooling tower salt drift, noise, bird collisions with nuclear power plant structures and transmission lines; impacts connected with herbicide application and landscape management; and potential water use conflicts connected with cooling water withdrawals and concluded that these would be SMALL. During operations, the replacement power SMR facilities would have similar impacts on terrestrial resources as North Anna 1 and 2. Impacts during construction of the replacement power facilities would be greater, but these would be temporary and mitigated by use of best management practices and revegetation of disturbed land.

3.6.7 New Nuclear (Small Modular Reactor) Alternative

In its ER, Dominion (VEPCO 2020-TN8099) assumes that the new nuclear alternative consisting of a cluster of SMRs would be built onsite in the area that the NRC previously licensed in an ESP for proposed North Anna Unit 3. This area includes 200 ac (81 ha) of land, of which 120 ac (49 ha) is developed and 80 ac (32 ha) is forested. If the licensee were building Unit 3, the area of land permanently disturbed for construction and operation would be 120 ac (49 ha). An additional maximum of 90 ac (36 ha) would be temporarily disturbed for construction and laydown areas but later revegetated (NRC 2010-TN6). In comparison with proposed Unit 3, the NRC estimates that the operational footprint area for the new cluster of five SMRs would be larger at 170 ac (69 ha). The five SMRs would use existing North Anna transmission infrastructure and intake and discharge structures. However, the licensee would build new mechanical draft cooling towers for closed-cycle cooling.

The forested portion of the ESP site is relatively recent regrowth that is vegetated with conifers, hardwoods, shrubs, and herbaceous plants (NRC 2010-TN6: Section 4.4.1). Clearing this forested area would displace wildlife to relatively large tracts of adjacent forest to the north, west, and south of the ESP site. Some wildlife mortality would be inevitable, especially among less mobile animals such as toads, lizards, turtles, snakes, moles, voles, and mice (NRC 2006-TN8385). According to the NRC’s (2010-TN6) combined license EIS, there are no important terrestrial animal species or habitats on the North Anna ESP site. A few small wetland areas (6.7 ac [2.7 ha]) and two intermittent streams exist on the ESP site (NRC 2010-TN6). Construction of Unit 3 would permanently disturb approximately 0.31 ac (0.13 ha) of nontidal wetlands and 757 linear ft (231 m) of ephemeral streams (VEPCO 2020-TN8099: p. E7-17). Since the proposed SMR cluster would have a larger footprint, the NRC staff assumes it would disturb the same area of wetlands plus additional wetland areas. Dominion would have to perform wetland delineations of affected lands and apply for permits for any wetland fill from USACE and VDEQ. The NRC staff expects that any Federal or State permits authorizing wetland impacts would require mitigation. Wetland losses of this magnitude can typically be mitigated through various forms of compensatory wetland mitigation, such as mitigation banks.

The NRC staff recognizes that the affected land provides habitat for the terrestrial wildlife listed in Section 3.5 of this EIS and some of the important State-listed or otherwise protected species described in Section 3.5.3. Construction noise could affect wildlife in adjoining forested areas and wetlands. Operational noise from the new cooling towers could also impact wildlife.

Five State-listed species (that are not also federally listed) could possibly occur on or near the ESP site: the loggerhead shrike (*Lanius ludoviciana*), little brown bat, Rafinesque’s eastern big-eared bat (*Corynorhinus rafinesquii macrotis*), tricolored bat (*Perimyotis subflavus*), and Virginia Piedmont water boatman. As described in Section 3.6.3.2, “State-Listed Species,” of this report, recent surveys for these species have not located any individuals within 6 mi

(9.7 km) of the North Anna site. The loggerhead shrike was spotted 7 mi (11 km) away in Mineral, Virginia. Nevertheless, it is possible that State-listed species, especially highly mobile species such as birds and bats, could occur on the site and could lose habitat. Migratory birds also will lose habitat.

To minimize construction-related impacts on wildlife, Dominion represented that it would adhere to State permit conditions that may restrict the timing of certain construction activities to minimize impacts on breeding birds (VEPCO 2020-TN8099). After completion of the five-SMR cluster, Dominion (VEPCO 2020-TN8099) would revegetate the cleared but undeveloped land. Wildlife species able to adapt to human disturbance, such as raccoons (*Procyon lotor*), opossum *(Didelphis virginiana*), mockingbirds (*Mimus polyglottus*), and northern cardinals (*Cardinalis cardinalis*), could then reoccupy the land (NRC 2006-TN8385).

As the new nuclear SMR facility would use existing North Anna transmission lines, the NRC staff expects no increased potential in wildlife injury from transmission lines. However, the SMR cluster will require adding new, tall structures to the landscape, including mechanical draft cooling towers, 65 ft (20 m) in height, and a power block, 160 ft (50 m) in height. These could result in avian (bird) collisions. In addition, bats, including State-listed bat species noted in Section 3.5.3, could collide with the towers and die. However, the NRC staff expects that bird and bat populations would become accustomed to the presence of the towers and avoid them. Once the SMR cluster is built, operational impacts on terrestrial resources would likely remain as expected for the proposed action. Based on the preceding analysis, the NRC staff concludes that impacts on terrestrial resources from the new five-SMR option of would be SMALL.

3.6.8 Combination Alternative (Solar, Offshore Wind, Small Modular Reactor, and Demand-Side Management)

Solar Photovoltaic

Impacts on terrestrial habitats and biota from the construction and operation of solar photovoltaic plants as part of the combination alternative would depend largely on the amount of land required and the location of the land. The NRC staff estimates that the solar portion of the alternative would require 20,000 ac (8,000 ha) of cleared land for eight solar photovoltaic plants in the North Anna ROI with access to Dominion transmission infrastructure. If the land chosen for the plants was previously cleared and used for industrial activity, impacts on terrestrial resources would be less significant than if the lands were virgin forest containing important species and habitats. Once in operation, solar photovoltaic plants pose special hazards to birds through collisions with photovoltaic equipment and transmission lines, electrocution from substation and distribution lines, and predation when injured after collision (Hathcock 2019-TN8470). Another less understood cause for bird collisions is known as the lake effect theory. Birds, especially migrating waterfowl and shorebirds, perceive the horizontally polarized light of photovoltaic solar panels as bodies of water and are injured or killed when they attempt to land on the panels as if they were water (Horvath et al. 2009-TN897). Water-seeking insects can also collide with the panels for the same reasons. In large enough numbers, such insect deaths may affect food webs. The Multiagency Avian-Solar Collaborative Working Group is a collection of Federal and State agencies identifying information needs and best practices for reducing avian impacts from solar energy. Collaboration with government agencies on best practices in the construction and siting of the solar installations can mitigate their impacts on birds. The NRC staff concludes that the impacts on terrestrial resources would be MODERATE to LARGE because the solar plants require large areas of land and clearing the land could result in the significant loss of wildlife, habitats, and vegetation.

Offshore Wind

During construction of an offshore wind facility, terrestrial habitats and biota may be impacted by onshore activities such as installation of interconnection cables, fiber optic cables, and switch cabinets and construction of interconnection stations. Species may experience habitat loss directly from excavation or indirectly from pollutants from drilling fluids. Wildlife could be disturbed by drilling and other operational noise and human activity during the construction period. However, regulations in the Virginia Coastal Zone Management Program prohibit onshore construction near sensitive coastal resources such as wetlands. As with the pilot portion of the project, onshore construction activities for the commercial portion of Dominion's Coastal Virginia Offshore Wind project would likely occur in disturbed areas such as parking lots, roadways, and ROWs, where terrestrial biota are already adapted to human activity (BOEM 2015-TN8399). In addition, Dominion has proposed that all onshore construction for the commercial portion of the project occur within the boundaries of the State Military Reservation in Virginia Beach, a military site that the National Guard Bureau uses primarily for training the Virginia National Guard and other State National Guard units. The NRC staff presumes that wildlife in the area has long been acclimated to unexpected loud noises, such as from the rifle range, and other human activity involved in military training. The additional noise and human activity from the construction of the onshore components of the offshore wind facility would be temporary and result in minimal permanent loss of habitat.

During operations, offshore wind turbines can impact terrestrial resources largely through collision of bats and birds with rotating turbine blades. The NRC staff estimates that the combination alternative would require 72 offshore wind turbines to generate the needed replacement power. The current proposal for Dominion's Coastal Virginia Offshore Wind project places the turbines in an offshore leased area 21–43 mi (34–69 km) east of the Virginia Beach shore (BOEM 2012-TN8471).

Concerning bat collisions, bat activity drops off after 12.4 mi (20 km) from shore in the Mid-Atlantic (Sjollema et al. 2014-TN8472). It is thus unlikely that nonmigratory cave dwelling bats would be present at turbines approximately 27 mi (43 km) from shore (BOEM 2015-TN8399). However, it is possible that some migratory tree bats may pass through the turbine sites during migration. The migratory tree bat species that could occur at the turbine sites are the silver-haired bat, eastern red bat, and the hoary bat (Cryan and Brown 2007-TN8487). The three State-listed bat species for North Anna (the little brown bat, the tricolored bat, and Rafinesque's big-eared bat) would not occur near the turbine sites.

Compared to bats, impacts on birds from the operations of offshore wind turbines are an issue of greater concern. The Coastal Virginia Offshore Wind project will operate in the Atlantic Flyway, a major migratory route for birds that are protected under the Migratory Bird Treaty Act. In addition to direct bird mortality from collision, offshore wind farms in general can disrupt bird flight formations and create barriers between areas that are ecologically linked, such as between roosting sites and feeding sites, breeding sites and wintering sites, and migration route points (Exo et al. 2003-TN8488). The maintenance and repair of wind turbines will increase boat activity in the area, which can be very disruptive to some bird species that will change course to avoid boats by as much as several kilometers (Exo et al. 2003-TN8488).

Impacts on birds from collision with offshore wind turbines are difficult to accurately quantify because downed individuals will sink or be swept away by the ocean where they cannot be collected and counted. Avian mortality rates at onshore wind turbines have been extensively studied and are estimated as an average of 5.3 birds killed per turbine per year (Loss et al.

2013-TN8489). However, offshore wind farms tend to use much larger turbines in larger numbers and operate in areas where the background noise from wind and waves hamper bird acoustic perceptions (Exo et al. 2003-TN8488). These differing conditions make it difficult to use onshore turbine bird mortality rates as the starting point for estimating offshore turbine bird mortality rates (Exo et al. 2003-TN8488). Nevertheless, in its environmental assessment for the Coastal Virginia Offshore Wind pilot project, the Bureau of Ocean Energy Management estimated that, for an offshore wind turbine located 27 mi (43 km) from the Virginia Beach shore, the yearly bird mortality rate could be much lower than 5.3, as there are fewer birds in the open ocean and many birds avoid turbine sites (BOEM 2015-TN8399). A total of 13 bird surveys conducted in the Coastal Virginia Offshore Wind project area recorded the presence of 45 bird species.

Of these, a large, long-lived seabird called the northern gannet *(Morus bassanus*) would be the bird species most affected by collision with the turbines. The northern gannet, which is protected under the Migratory Bird Treaty Act (85 FR 21282-TN8390), represented 81 percent of all bird individuals observed in the area. It was also the bird species most likely to fly at the height of the rotary sweep. The Migratory Bird Treaty Act makes it illegal to take any migratory bird (or parts, nests, or eggs) except under a valid permit issued under Federal Regulations, and Dominion would likely need such a permit for a take of northern gannet and other pelagic birds. For its two-turbine Coastal Virginia Offshore Wind pilot project, the estimated take was one northern gannet individual killed per year (BOEM 2015-TN8399). Stated another way, the estimated take was 0.5 northern gannet individuals per turbine per year. For the 72 turbines required for the combination alternative, the number of northern gannets killed per year would be far greater because there are more turbines spread out over a much larger area. Also, the 14-MW turbines for the commercial project are approximately 33 percent taller in height and 48 percent wider in rotary span than the 6-MW pilot turbines, which could result in a greater potential for bird collision. However, even if the northern gannet take rate increased sixfold from 0.5 individuals per turbine per year to 3 individuals per turbine per year, the estimated loss would be 216 northern gannet individuals per year. This number would not be likely to significantly affect the species. The International Union for the Conservation of Nature (Birdlife International 2018-TN8490) lists the northern gannet as a species of least concern because it has a very large range and its population is increasing (BirdLife International 2023-TN8491), by some estimates as much as 3 percent per year. Birds protected under the Bald and Golden Eagle Protection Act would not occur near the turbines, as golden eagles do not nest in Virginia and typically migrate along the Appalachian mountain ridgelines, and bald eagles do not occur in the open ocean (BOEM 2015-TN8399).

Based on the above analysis, the impact on terrestrial resources from construction and operation of an offshore wind facility as part of the combination alternative would be MODERATE.

<u>Small Modular Reactor</u>

The terrestrial impacts for the construction and operation of one SMR as part of the combination alternative would be similar to but less than the terrestrial impacts described above (in Section 3.6.7) for the new nuclear alternative. The operation of one SMR would require a much smaller footprint (approximately 21 percent of the footprint size of the five-SMR cluster). A smaller area of forested land and wildlife habitat would be temporarily or permanently disturbed during construction, and there would likely be a shorter period of construction noise and activity to disturb wildlife. Construction of new taller structures at the North Anna site; namely a new mechanical cooling tower and power block, would result in increased avian and bat collisions.

Noise from the operation of the cooling tower could also disturb wildlife. Based on the above information and the analysis and conclusion reached in Section 3.5.7 of this EIS, the NRC staff concludes that terrestrial impacts from construction and operation of one SMR as part of the combination alternative would be SMALL.

Demand-Side Management

The NRC has not identified any impacts on terrestrial resources associated with demand-side management.

Combination Alternative Conclusion

Based on the above discussion of solar photovoltaic, offshore wind, SMR, and demand-side management, the NRC staff concludes that the overall impacts on terrestrial resources from the combination alternative could range from SMALL to LARGE, mainly due to the large area of land and the types of land that could be used for the solar photovoltaic portion and the operational impacts of the offshore wind portion of the alternative.

3.7 Aquatic Resources

This section describes the aquatic resources of the affected environment, including Lake Anna and the North Anna River. The NRC staff has previously characterized these resources in detail in Section 2.2.5 of the SEIS for initial license renewal (NRC 2002-TN665), Section 2.7.2 of the ESP EIS (NRC 2006-TN8385) and Section 2.7.2 of the COL EIS (NRC 2010-TN6). Section E3.7.1 of Dominion’s ER (VEPCO 2020-TN8099: p. E-3-137 to E-3-142) also describes aquatic resources. This information is incorporated here by reference, with key, new, and updated information summarized below in the following subsections. Following the description of the aquatic environment, the staff analyzes the potential impacts on these resources that would occur as a result of the proposed action (SLR) and alternatives.

3.7.1 Lake Anna

Lake Anna is a 17 mi (27 km)-long human-made impoundment of the North Anna River. Lake Anna remains connected to the river via the North Anna Dam, which includes a spillway and the North Anna Hydro Power Station. The lake is typical of many shallow reservoirs in the southern and Mid-Atlantic region. It contains three trophic conditions. The upper portion of the lake is eutrophic, the lower portion is oligotrophic, and the middle is a blend of the two conditions. Following impoundment, high nutrient levels facilitated an initially highly productive biotic community. The aquatic environment exhibited rapid ecological succession during the 1970s. In the 1980s, productivity subsequently decreased, the aquatic community gradually shifted from riverine to lake, and the community ultimately stabilized by the mid-1980s.

Lake Anna can be divided into two distinct sections: the 9,600 ac (3,900 ha) reservoir and the 3,400 ac (1,400 ha) WHTF used for North Anna cooling. During operations, North Anna discharges heated effluent to the WHTF through a single discharge canal located 200 ft (60 m) south of the intake location. Water flows from the discharge canal through a series of three lagoons before reentering the reservoir portion of the lake. The WHTF is separated from the reservoir by a series of dikes. A weir at Dike 3 allows water to flow from the WHTF back into the reservoir. Fish can swim from the reservoir into the WHTF and back. Therefore, the same aquatic community occurs in both regions of the lake.

3.7.1.1 Biological Communities of Lake Anna

The trophic structure of Lake Anna includes primary producers (plankton, macrophytes, and periphyton), primary consumers (zooplankton and benthic macroinvertebrates), and bottom-feeding, planktivorous, and piscivorous fish that serve as secondary and tertiary consumers. Primary producers are organisms that capture solar energy and synthesize organic compounds from inorganic chemicals. They form the trophic structure's foundation by producing the organic nutrients and energy used by consumers. Primary producers in lake systems include phytoplankton, aquatic macrophytes, and periphyton. Of the three, phytoplankton are the major producers in all but very shallow lakes. Figure 3-6 illustrates the trophic structure of Lake Anna.

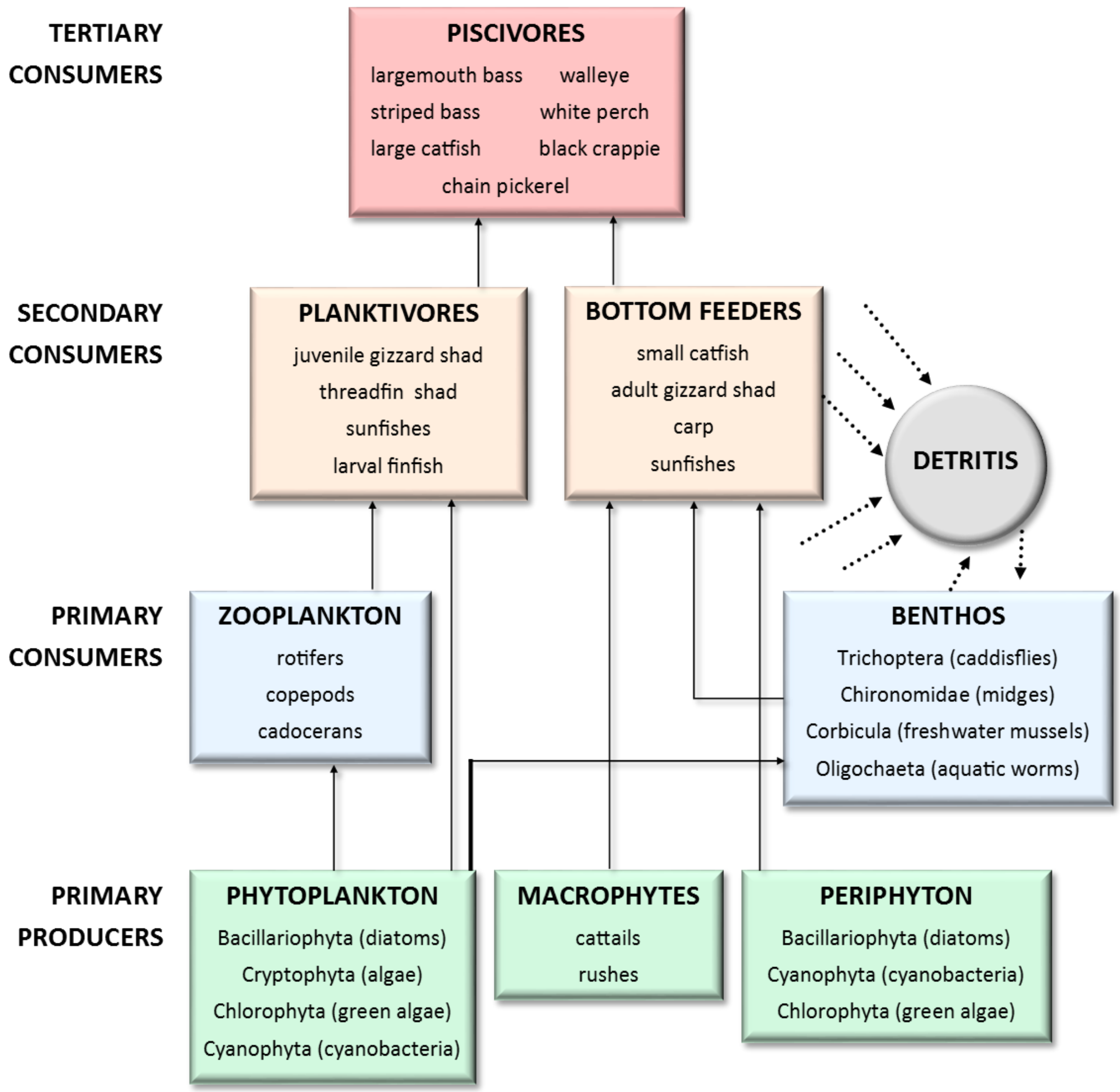


Figure 3-6 Trophic Structure of Lake Anna

Plankton

Plankton are small and often microscopic organisms that drift or float in the water column. Phytoplankton are single-celled plant plankton and include diatoms (single-celled yellow algae) and dinoflagellates (a single-celled organism with two flagella). Phytoplankton live suspended in the water column and occur in the limnetic (open water) zone of a lake. Seventy-seven genera of phytoplankton are known to occur in Lake Anna. Diatoms (Bacillariophyta), green algae (Chlorophyta), blue-green algae (Cyanophyta), and dinoflagellates (Pyrrophyta) are the most dominant groups (VEPCO 1986-TN8397).

Zooplankton are animals that either spend their entire lives as plankton (holoplankton) or exist as plankton for a short time during development (meroplankton). Zooplankton include rotifers, isopods, protozoans, marine gastropods, polychaetes, small crustaceans, and the eggs and larval stages of insects and other aquatic animals. Sixty-six taxa of zooplankton are known to occur in Lake Anna. Polyarthra, Keratella (common rotifers), and Bosmina (a common cladoceran) are most abundant (VEPCO 1986-TN8397).

Macrophytes and Periphyton

Aquatic macrophytes are large plants, both emergent and submerged, that inhabit shallow water areas. Periphyton consists of single-celled or filamentous species of algae that attach to benthic or macrophytic surfaces. Macrophytes and periphyton occur in the littoral (nearshore and shallow) zone. They tend to be highly productive because they have more access to nutrients through their roots than do phytoplankton. Macrophytes within Lake Anna include cattails and rushes.

Benthic Invertebrates

Benthic invertebrates inhabit the bottom of the water column and its substrates. They include macroinvertebrates (clams, crabs, oysters, and other shellfish) as well as certain zooplankton, such as polychaetes (described previously). Researchers have collected 124 benthic taxa from the Lake Anna region before impoundment. In pre-impoundment collections, the eastern elliptio (*Elliptio complanatus*), Atlantic spike (*E. producta*), and striated fingernail clam (*Sphaerium striatum*) were prevalent in the North Anna River basin. Currently, the introduced Asian clam (*Corbicula* spp.) dominates benthic invertebrate collections from both Lake Anna and the lower North Anna River (VEPCO 2020-TN8099).

In 2008, Creek Laboratory, LLC conducted a mussel survey in Lake Anna in fulfillment of VPDES permit requirements. Dominion reported the results of this effort in Appendix 1 of its 2008 Lake Anna and lower North Anna River environmental study annual report (VEPCO 2021-TN8268). Researchers collected specimens through shoreline searches, snorkeling, and SCUBA diving at 22 sites throughout Lake Anna on 5 days in the fall of 2008. The three most common species were eastern elliptio, eastern floater (*Pyganodon cataracta*), and pond papershell (*Utterbackia imbecilis*). Eastern floater and pond papershell were found throughout Lake Anna in soft substrate, such as deep silt or detritus. Eastern elliptio were found in the WHTF, mid-lake, and lower lake locations in a variety of substrates but most commonly in mixed sand and gravel. Asian clams were also present throughout the survey area. Mussels were most abundant within the WHTF lagoons, although Creek Laboratory states, in its survey report, that the cause of this is unknown and may be due to temperature regime, relatively constant current, better substrate in the WHTF than in other areas of the lake, or a combination of these factors. Researchers found no federally or State-listed freshwater mussels at any of the survey sites.

Ichthyoplankton

Because Lake Anna is a closed system, ichthyoplankton of all aquatic species that inhabit the lake are present. Ichthyoplankton have been sampled during three periods. From 1978 to 1983, VEPCO performed entrainment sampling at the North Anna intake in connection with a CWA Section 316(b) demonstration (Dominion 2005-TN8446). In 1984 and 1985, VEPCO collected ambient ichthyoplankton samples throughout the lake in support of its CWA Section 316(a) demonstration (VEPCO 1986-TN8397). In 2016 and 2017, HDR Engineering, Inc. (HDR) performed entrainment sampling at the North Anna intake in connection with an updated CWA Section 316(b) demonstration (VEPCO 2021-TN8268). Larvae of black crappie (*Pomoxis nigromaculatus*), white perch (*Morone americana*), yellow perch (*Perca flavescens*), gizzard shad (*Dorsoma cepedianum*), and sunfishes (*Lepomis* spp.) were the most prevalent taxa collected during each of these sampling efforts. Notably, no fish eggs were collected in the 1978–1983 entrainment samples or in the 1984–1985 ambient samples, and only a relatively small number of nonviable eggs were collected in 2016–2017 entrainment samples. This is likely because most species of fish in Lake Anna produce demersal, adhesive eggs that do not occur in the water column where sampling occurred. Table 3-11 lists the ichthyoplankton taxa reported during each of the three studies. Section 3.7.3.1.2 of this EIS discusses the results of the two entrainment studies in detail.

Juvenile and Adult Fish

Over 40 species of fish representing 16 families have been reported from Lake Anna NRC 2010-TN6). Fish within the lake are a combination of those originating from the North Anna River and local farm ponds during initial impoundment and those introduced by VDGIF, which manages Lake Anna’s fish populations. Recreationally important species include largemouth bass (*Micropterus salmoides*), striped bass (*Morone saxatilis*), bluegill (*Lepomis macrochirus*), yellow perch, black crappie, white perch, pumpkinseed (*L. gibbosus*), redear sunfish (*L. microlophus*), redbreast sunfish (*L. auritus*), channel catfish (*Ictalurus punctatus*), and white catfish (*Ameiurus catus*). Primary forage species include threadfin shad (*Dorosoma petenense*), gizzard shad, and blueback herring (*Alosa aestivalis*).

Since its creation, the VDGIF has stocked Lake Anna to support recreational fishing. Initial introductions included largemouth bass, bluegill, redear sunfish, and channel catfish (VDWR 2023-TN8450). Subsequently, the VDGIF stocked channel catfish, largemouth bass (northern and southern strains), redear sunfish, striped bass, and walleye to improve and diversify the fishery. In the 1980s, VDGIF introduced blueback herring and threadfin shad to provide forage for pelagic predators. In 1994, VEPCO, under VDGIF’s approval, stocked the WHTF with sterile triploid herbivorous grass carp (*Ctenopharyngodon idella*) to control the growth of the nuisance plant hydrilla (*Hydrilla verticillata*) (NRC 2002-TN665). Today, VDGIF continues to stock striped bass annually. All other species are self-sustaining.

Since 1987, Dominion has conducted quarterly gill net and electrofishing sampling of Lake Anna. Researchers set nets in February, May, August, and November at 15 locations throughout the lake and WHTF (six gill net stations and nine electrofishing stations) (see Figures 5 and 8 in VEPCO 2021-TN8268). All sampling is performed in accordance with Dominion’s 2014 study plan (VEPCO 2021-TN8268), which VDEQ and VDGIF have reviewed and approved to ensure that the plan addresses the relevant VPDES permit and CWA Section 316(a) requirements.

Gizzard shad, channel catfish, white perch, threadfin shad, largemouth bass, and white catfish are typically the numerically dominant species caught in gill net samples. Centrarchids (sunfishes, including largemouth bass) are typically the numerically dominant taxa collected by electrofishing. Since sampling began, gill net catch per unit effort (CPUE) for channel catfish has slowly increased throughout Lake Anna; gill net CPUEs for white perch and white catfish have been consistent; and gill net CPUEs for gizzard shad and threadfin shad have exhibited high annual variability and seem to follow a cyclical pattern. Within the WHTF, gill net CPUEs for channel catfish and gizzard shad have been highly variable over time, while gill net CPUEs for white perch, largemouth bass, and white catfish have been relatively stable. Electrofishing CPUEs of the most numerically dominant species, including bluegill, green sunfish, redbreast sunfish, largemouth bass, and redear sunfish, have exhibited high variation over time but appear to oscillate over distinct averages (VEPCO 2021-TN8268).

During the period 2015–2019, Dominion's researchers have collected a total of 34 species of fish representing 10 families by gill net and electrofishing combined. Table 3-12 lists each collected taxon by family. Full results of Dominion's Lake Anna fish sampling appear in its annual reports (VEPCO 2021-TN8268). Dominion's study plan (VEPCO 2021-TN8268) describes sampling methods and materials in detail.

VDGIF also performs periodic sampling to support its management of the reservoir's fisheries and to inform future stocking. Table 3-12 lists fish taxa collected by VDGIF in Lake Anna over the period 2003–2015, as reported in a 2016 *Lake Anna Fisheries Management Report* (VDGIF 2016-TN8451). Unlike Dominion, VDGIF does not distinguish between lake and WHTF sampling stations during its sampling; thus, taxa in Table 3-12 are reported for the entirety of Lake Anna.

3.7.1.2 Important Species and Habitats of Lake Anna

This section summarizes important fisheries of Lake Anna as well as State-protected and other special status species. Section 3.8 discusses federally listed species separately; however, none occur in Lake Anna.

Commercially Important Fisheries

Commercial fishing is not permitted on Lake Anna. Thus, there are no commercially important fisheries.

Recreationally Important Fisheries

Lake Anna is a popular angling destination. The lake experiences moderate fishing pressure for its size. Species most sought by anglers, in order of preference, are largemouth bass, striped bass, black crappie, and sunfish. According to VDGIF's most recently available fisheries management report, annual fishing pressure within the lake has varied from between 12.8 and 13.7 hours per acre since 2005 (VDGIF 2016-TN8451). Table 3-8 lists the mean abundance of recreationally important species for the period 2003–2015.

Although VDGIF has stocked a number of species since the lake's impoundment, in the past 20 years, the agency has only stocked striped bass and walleye hybrids (e.g., saugeye), and currently VDGIF only stocks striped bass (VDGIF 2016-TN8451). VDGIF has varied its stocking rates and locations in an attempt to determine optimum future stocking rates for Lake Anna.

Table 3-8 Mean Abundance of Recreationally Important Fish in Lake Anna, 2003–2015

Scientific Name	Common Name	Mean Abundance[(a)]
Morone americana	white perch	12.0
Pomoxis nigromaculatus	black crappie	8.6
Ictalurus punctatus	channel catfish	5.7
Morone saxatilis	striped bass	5.2
Ameiurus catus	white catfish	3.1
Micropterus salmoides	largemouth bass	1.5
Lepomis macrochirus	bluegill	0.5
Lepomis microlophus	redear sunfish	0.4
Ictalurus furcatus	blue catfish	0.1
Lepomis auritus	redbreast sunfish	0.1
Perca flavescens	yellow perch	0.1
Lepomis gibbosus	pumpkinseed	—
Micropterus dolomieu	smallmouth bass	—
Morone chrysops x saxatilis	striped bass hybrid	—
Sander vitreus	walleye	—
Stizostedion vitreum x canadense	saugeye	—

(a) Fish per net, per night; — = not reported.
Source: VDGIF 2016-TN8451.

VDGIF has stocked striped bass and hybrids at an average rate of 18 fish per acre, which is considerably higher than rates for other large southeastern reservoirs. Striped bass in Lake Anna exhibit rapid juvenile growth followed by slow adult growth, which is a typical pattern in southeastern reservoirs containing marginal habitat. Summer temperatures and dissolved oxygen conditions at Lake Anna are typically marginal for adult fish, especially in the lower portion of the reservoir. VDGIF stocked striped bass hybrids in 2014 on a 1-year experimental basis. Hybrids typically perform better within marginal habitat.

VDGIF stocked saugeye (a walleye hybrid) in 2013 at a rate of 10 fish per acre as part of an experiment to determine whether this hybrid would perform better in Lake Anna than walleye. Although this was originally a one-time stocking event, VDGIF is considering periodic future stocking of this species.

<u>State-Protected and Other Special Status Species</u>

The Commonwealth of Virginia enacted the Virginia Endangered Plant and Insect Species Act (Va. Code Section 3.2-1000 et seq.; TN8536) in 1979 to protect Virginia-endemic species from possible extinction throughout all or a significant part of those species' native ranges. Under the authority of this act, VDGIF lists fish, mollusks, freshwater crustaceans, and marine mammals as State endangered or threatened. Additionally, under the Virginia Wildlife Action Plan (VDGIF 2015-TN8452), VDGIF identifies many aquatic species as Species of Greatest Conservation Need. The distribution and abundance of such species are indicative of the greater diversity and health of wildlife within the State.

No State-listed species or Species of Greatest Conservation Need occur in Lake Anna (VEPCO 2020-TN8099; VDCR 2023-TN8453; VDGIF 2023-TN8448; VDGIF 2023-TN8449).

The American eel (*Anguilla rostrata*) inhabits Lake Anna and is a Tier III species ("High Conservation Need") in the Virginia Wildlife Action Plan (VDGIF 2015-TN8452). It is an elongated, snakelike fish native to freshwater rivers and streams throughout North and South America. The species is catadromous and spawns in the Sargasso Sea of the Western Atlantic. It spends its adult life in streams with continuous flow or in muddy, silt-bottomed lakes. Adults usually feed at night on worms, small fish, crustaceans, clams, and other mollusks. Dominion researchers collected one individual of this species in Lake Anna by electrofishing in May 2019 (VEPCO 2021-TN8268). This species has not otherwise been reported from Lake Anna. American eel were likely introduced into Lake Anna during initial impoundment.

3.7.1.3 Invasive and Nuisance Species of Lake Anna

Nonnative species are those species that are present only because of introduction and that would not naturally occur either currently or historically in an ecosystem. Invasive species are nonnative organisms whose introduction causes or is likely to cause economic or environmental harm or harm to human, animal, or plant health (81 FR 88609-TN8375). For purposes of this discussion, nuisance species are nonnative species that alter the environment but that do not rise to the level of invasive.

Invasive and nuisance aquatic species in Lake Anna include hydrilla, the northern snakehead (*Channa argus*), and the Asian clam.

Hydrilla is an exotic submerged aquatic plant that occurs in still or slow-moving freshwater and can tolerate a wide range of conditions, which allows it to out-compete native vegetation. It became established in Lake Anna in the 1980s. In 1994, Dominion, in coordination with the State, released sterile triploid herbivorous grass carp (*Ctenopharyngodon idella*) to control the growth of this nuisance plant (VEPCO 2020-TN8099). Dominion has also developed a hydrilla management plan in coordination with local stakeholders and agencies. The plan includes a citizen-led monitoring program, grass carp stockings, and herbicide application. Currently, hydrilla in the reservoir and WHTF portions of Lake Anna is minimal. In 2019, the plant's presence did not necessitate any specific management or control.

The northern snakehead is a predatory fish native to parts of Asia and Russia. As an invasive species, it out-competes native top-level predators and can substantially deplete available food resources, including zooplankton, larvae, small fish, and crustaceans. It is also able to survive in waters with low oxygen concentrations. Snakeheads were found to be self-sustaining in the York drainage of Lake Anna as of 2017 (VDWR 2018-TN8454). Dominion researchers also collected one snakehead in the North Anna arm of the lake during 2019 electrofishing surveys. Dominion maintains procedures concerning snakeheads that require personnel to report collection and location of the catch and to kill the individual(s) in accordance with State-level invasive species guidance.

The Asian clam, which is now ubiquitous in many major U.S. freshwater systems, is capable of surviving in relatively cold waters and reproduces rapidly. Once established, Asian clams can alter benthic substrates, out-compete other native benthic invertebrates, and cause the decline or local disappearance of native mussel and clam populations. Asian clams are particularly damaging to intake pipes for power and water facilities when large numbers of the clams, either dead or alive, clog the pipes. Individuals will also biofoul the pipes by attaching themselves to pipe walls where they incrementally obstruct more flow as they grow. Although present in Lake Anna, Asian clams have not yet occurred in concentrations that would necessitate Dominion to take management actions, such as low-level chlorination or biocide application

(VEPCO 2020-TN8099). In 1990, Dominion initiated a semiannual sampling program to monitor the Asian clam population. Sampling indicates that the population is highly variable. In grab sample surveys of two locations in Lake Anna and two locations in the WHTF over the period 1991–2019, researchers collected from 22 individuals (2019) to 201 individuals (2011). Dominion maintains procedures and protocols to control the proliferation of the Asian clam. These include saving specimens of any mussels or clams found in North Anna water systems for inspection and identification and implementation of boat and trailer disinfection procedures.

3.7.2 North Anna River

The North Anna River downstream of the North Anna Dam is small (ranging from 75–150 ft [23-45 m] wide), but it supports a diverse assemblage of freshwater species. Fish abundance and diversity have steadily increased following Contrary Creek mine site reclamation and restoration, which began soon after impoundment of the river and creation of Lake Anna. The North Anna River joins the South Anna River 23 mi (37 km) downstream from the North Anna Dam to form the Pamunkey River.

3.7.2.1 Biological Communities of the North Anna River

Like many southern streams, the North Anna River periphyton community is dominated by diatoms. Immediately downstream of Lake Anna, caddisflies compose the majority of the benthic macroinvertebrate community. Farther downstream, macroinvertebrate communities show more diversity and are similar to those of the South Anna River (NRC 2002-TN665).

The river's fish community includes a diverse assemblage of stream fishes. Over 35 species of 13 families have been reported from the North Anna River downstream of the dam. Redbreast sunfish are consistently among the most abundant species in the river. Satinfin shiner (*Cyprinella analostana*), American eel, rosyface shiner (*Notropis rubellus*), rosefin shiner (*Lythrurus ardens*), swallowtail shiner (*Notropis procne*), and margined madtom (*Noturus insignis*) are also relatively common. Recreationally important species include smallmouth bass, bluegill, and striped bass. Dominion samples the fish community of the North Anna River below the dam three times each year using electric seine and backpack electrofishing. Researchers collect samples in May, July, and September at four river stations bordering Louisa, Spotsylvania, Hanover, and Caroline counties (see Figure 12 in VEPCO 2021-TN8268). Researchers perform sampling in accordance with Dominion's study plan (VEPCO 2021-TN8268), and Dominion reports its results to VDEQ and VDGIF annually. Species richness, which is measured by the number of species present in the North Anna River, has consistently been high during sampling efforts. Over the period 1999–2018, mean species richness was 26. Dominion also calculates diversity and evenness indices. Shannon's diversity index uses species abundance and evenness to calculate richness. If abundance is primarily concentrated in one species, the index will be closer to zero. Diversity in North Anna River samples is fairly consistent year to year. This value ranged from 1.96 to 2.5 over the period 1999–2019 with an average score of 2.25. Pielou's evenness index is the count of individuals of each species in an area and ranges from 0 (no evenness) to 1 (complete evenness). Evenness in North Anna River samples is also consistent year to year. This value ranged from 0.6 to 0.8 over the period 1999–2019, with an average score of 0.7.

VDGIF also periodically samples the North Anna River to assess the condition of recreational fisheries. Of particular interest in the lower river are largemouth and smallmouth bass because these species are the most sought after by anglers. Since 2006, VDGIF has released no new sampling reports or data on the North Anna River. Summaries of VDGIF's 2006 and other past sampling efforts are reported in Section 2.7.2.3 of the NRC's ESP EIS (NRC 2006-TN8385) and Section 2.7.1.1 of the COL EIS (NRC 2010-TN6).

3.7.2.2 Important Species and Habitats of the North Anna River

This section summarizes important fisheries of the North Anna River as well as State-protected and other special status species. Section 3.7 discusses federally listed species separately.

Commercially Important Fisheries

Commercial fishing is not permitted in the North Anna River (VEPCO 2020-TN8099; NRC 2010-TN6). Thus, there are no commercially important fisheries.

Recreationally Important Fisheries

The most sought-after species in the North Anna River include smallmouth bass, bluegill, and striped bass. VDGIF sampled the North and South Anna Rivers in connection with the proposed North Anna Unit 3 in 2008. Table 3-9 lists the mean sampling abundance of recreationally important species collected during this effort.

Table 3-9 Mean Sampling Abundance of Recreationally Important Fish in the North Anna River, 2006

Scientific Name	Common Name	Sampling Abundance[(a)]
Lepomis auritus	redbreast sunfish	1,107
Micropterus dolomieu	smallmouth bass	85
Micropterus salmoides	largemouth bass	39
Lepomis macrochirus	bluegill	7
Lepomis gibbosus	pumpkinseed	2
Lepomis microlophus	redear sunfish	2

(a) Fish per kilometer collected via electrofishing at three sampling sites.
Source: VDGIF 2008-TN8447.

State-Protected and Other Special Status Species

Four State-protected or Virginia Wildlife Action Plan priority species occur in Louisa and Spotsylvania counties (see Table 3-10). These species are as follows:

- dwarf wedgemussel (*Alasmidonta heterodon*)
- green floater (*Lasmigona subviridis*)
- American eel
- least brook lamprey (*Lampetra aepyptera*)

The dwarf wedgemussel is a small, greenish-brown freshwater bivalve that is endangered in Virginia. It is also federally listed as endangered under the ESA. Although the species occurs within Louisa and Spotsylvania Counties, VDGIF reports no occurrences of it within the North Anna River (VDGIF 2023-TN8448, VDGIF 2023-TN8449). Section 3.8 of this EIS describes the dwarf wedgemussel in further detail.

The green floater is a freshwater bivalve that inhabits streams and small rivers. It is threatened within Virginia and is a candidate for Federal listing under the ESA. The VDGIF reports occurrences of this species within the upper Pamunkey River watershed (VDGIF 2023-TN8448, VDGIF 2023-TN8449). Section 3.7 of this EIS describes the green floater in further detail.

Table 3-10 State-Protected Aquatic Species in the North Anna River

Scientific Name	Common Name	Protected Status(a)	WAP Ranking(b)	Conservation Opportunity(c)
Alasmidonta heterodon	dwarf wedgemussel	FE, SE	I	a
Lasmigona subviridis	green floater	CL, ST	II	a
Anguilla rostrata	American eel	-	III	a
Lampetra aepyptera	least brook lamprey	-	I	c
Alasmidonta heterodon	dwarf wedgemussel	FE, SE	I	a

(a) Endangered Species Act protection status as follows: CL = candidate for federal listing; FE = federally endangered; FT = federally threatened; PT = proposed to be listed as federally threatened; Commonwealth of Virginia protection status as follows: SE = State endangered; ST = State threatened.
(b) Virginia Wildlife Action Plan (WAP) status (I–IV) as follows: I = Tier I, Critical Conservation Need, II = Tier II, Very High Conservation Need; III = Tier III, High Conservation Need.
(c) WAP conservation opportunity rankings (a–c) as follows: a = on the ground management strategies/actions exist and can be feasibly implemented; b = on the ground actions or research needs have been identified but cannot feasibly be implemented at this time; c = no on the ground actions or research needs have been identified or all identified conservation opportunities have been exhausted.

The American eel is a Tier III ("High Conservation Need") species in the Virginia Wildlife Action Plan (VDGIF 2015-TN8452), but the State has not given it any formal protective status. Section 3.7.1.2 describes it briefly. Within the North Anna River, VDGIF reports occurrences of this species at Hawkins Creek and Long Creek (VDGIF 2023-TN8448, VDGIF 2023-TN8449). Dominion researchers have also collected the species during annual river sampling efforts described previously in this EIS.

The least brook lamprey is a Tier I ("Critical Conservation Need") species in the Virginia Wildlife Action Plan (VDGIF 2015-TN8452), but the State has not given it any formal protective status. It is a nonparasitic lamprey with a long, eel-shaped body and deeply notched dorsal fin. It prefers clean, clear gravel riffles and runs of creeks and small rivers. It is herbivorous in immature stages and does not feed as an adult. Within the North Anna River, VDGIF reports occurrences of this species at Hawkins Creek and Long Creek (VDGIF 2023-TN8448, VDGIF 2023-TN8449). Dominion researchers have also collected the species during annual river sampling efforts described previously in this EIS. In 2006, VDGIF collected the species at a CPUE of 13 individuals per kilometer over three electrofishing sampling sites (VDGIF 2008-TN8447).

3.7.2.3 Invasive and Nuisance Species of the North Anna River

The Center for Invasive Species and Ecosystem Health identifies over 200 invasive species in Louisa and Spotsylvania counties (CISEH Undated-TN8455). The Virginia Invasive Species Management Plan (VISAC 2018-TN8456) names the northern snakehead and zebra mussel (*Dreissena polymorpha*) to be the two aquatic invasive species of particular concern in Virginia's aquatic environments.

As stated in Section 3.7.1.3, "Invasive and Nuisance Species of Lake Anna," the northern snakehead is self-sustaining in Lake Anna. The Virginia Department of Wildlife Resources reports that the species does not occur south of the North Anna Dam (VDWR 2018-TN8454). The U.S. Geological Survey (USGS) Nonindigenous Aquatic Species Database includes one record of the species in Gold Mine Creek, a tributary stream of Lake Anna (USGS Undated-TN8457). However, the NRC staff identified no information confirming whether the species occurs in the North Anna River.

Table 3-11 Ichthyoplankton Taxa Reported from Lake Anna, 1978–1982, 1984–1985, and 2016–2017

Scientific Name	Family	Common Name[a]	Entrained Ichthyoplankton, 1978–1983[b]	Ambient Ichthyoplankton, 1984–1985[c]	Entrained Ichthyoplankton, 2016–2017[d]
Centrarchidae spp.	Centrarchidae	sunfishes			x
Lepomis macrochirus	Centrarchidae	bluegill[c]			x
Micropterus Ilmoi	Centrarchidae	largemouth bass[c]	x	x	x
Alosa aestivalis	Clupeidae	blueback herring			x
Clupeidae spp.	Clupeidae	herrings and shads			x
Dorsoma spp.	Clupeidae	gizzard or threadfin shad			x
Dorosoma cepedianum	Clupeidae	gizzard shad	x	x	x
Dorosoma petenense	Clupeidae	threadfin shad			x
Cyprinidae spp.	Cyprinidae	minnows			x
Notemigonus crysoleucas	Cyprinidae	golden shiner			x
Ameiurus catus	Ictaluridae	white catfish[c]			x
Pomoxis nigromaculatu	Ictaluridae	black crappie[c]	x	x	
Poxomis spp.	Ictaluridae	crappie	x		
Morone alicana	Moronidae	white perch[c]	x	x	x
Etheostoma spp.	Percidae	darter species			x
Perca flavescens	Percidae	yellow perch[c]	x	x	x
n/a	n/a	nonviable eggs			x
n/a	n/a	unidentified finfish			x

(a) All taxa reported were larvae. Viable eggs have not been collected in Lake Anna's water column. Nonviable eggs (i.e., unfertilized, dead, or decaying) were collected in 2016 and 2017 but were not identified by taxa.
(b) VEPCO 1986-TN8397, Table 6.3-2.
(c) Dominion 2005-TN8446, Table 6.1.1.
(d) VEPCO 2021-TN8268, Table 4-2.

Table 3-12 Fish Taxa Reported from Lake Anna, 2003–2019

Scientific Name	Family	Common Name	All Stations, 2003–2015[a]	Lake Stations, 2016–2019[b]	WHTF Stations, 2016–2019[c]
Amia calva	Amiidae	bowfin	-	x	x
Anguilla rostrata	Anguillidae	American eel	-	x	-
Carpiodes cyprinus	Catostomidae	quillback	x	x	x
Catostomus commersoni	Catostomidae	white sucker	x	x	-
Erimyzon oblongus creek	Catostomidae	chubsucker	x	-	-
Hypentelium nigricans	Catostomidae	northern hog sucker	x	-	-
Moxostoma macrolepidotum	Catostomidae	shorthead redhorse	x	x	x
Chaenobryttus gulosus	Centrarchidae	warmouth	x	x	x
Lepomis auritus	Centrarchidae	redbreast sunfish[c]	x	x	x
Lepomis cyanellus	Centrarchidae	green sunfish	x	x	x
Lepomis gibbosus	Centrarchidae	pumpkinseed[c]	-	x	x
Lepomis macrochirus	Centrarchidae	bluegill[c]	x	x	x
Lepomis microlophus	Centrarchidae	redear sunfish[c]	x	x	x
Micropterus salmoides	Centrarchidae	largemouth bass[c]	x	x	x
Alosa aestivalis	Clupeidae	blueback herring	x	x	-
Dorosoma cepedianum	Clupeidae	gizzard shad	x	x	x
Dorosoma petenense	Clupeidae	threadfin shad	x	x	x
Campostoma anomalum	Cyprinidae	central stoneroller	-	-	-
Ctenopharyngodon idelle	Cyprinidae	grass carp	x	x	x
Cyprinella analostana	Cyprinidae	satinfin shiner	-	x	-
Cyprinus carpio	Cyprinidae	common carp	x	x	x
Notemigonus crysoleucas	Cyprinidae	golden shiner	x	x	-
Notropis amoenus	Cyprinidae	comely shiner	-	x	-
Notropis hudsonius	Cyprinidae	spottail shiner	x	x	-
Semotilus corporalis	Cyprinidae	fallfish	x	-	-
Esox niger	Esocidae	chain pickerel	x	x	-
Ameiurus catus	Ictaluridae	white catfish[c]	x	x	x
Ictalurus furcatus	Ictaluridae	blue catfish[c]	x	x	-

Table 3-12 Fish Taxa Reported from Lake Anna, 2003–2019 (Continued)

Scientific Name	Family	Common Name	All Stations, 2003–2015[a]	Lake Stations, 2016–2019[b]	WHTF Stations, 2016–2019[c]
Ictalurus natalis	Ictaluridae	yellow bullhead	x	x	x
Ictalurus nebulosus	Ictaluridae	brown bullhead	x	x	x
Ictalurus punctatus	Ictaluridae	channel catfish[c]	x	x	x
Pomoxis nigromaculatus	Ictaluridae	black crappie[c]	x	x	x
Morone americana	Moronidae	white perch[c]	x	x	x
Morone chrysops x saxatilis	Moronidae	striped bass hybrid[c]	x	x	x
Morone saxatilis	Moronidae	striped bass[c]	x	x	x
Etheostoma olmstedi	Percidae	tessellated darter	-	x	-
Perca flavescens	Percidae	yellow perch[c]	x	x	-
Sander vitreus	Percidae	walleye[c]	x	-	-
Stizostedion vitreum x canadense	Percidae	saugeye[c]	x	x	x
TAXA COUNT	**n/a**	**n/a**	**32**	**34**	**23**

x = collected in survey samples; - = not collected in survey samples; n/a = not applicable.

(a) Taxa collected in Lake Anna gill net samples by VDGIF researchers as reported in Table 4 of VDGIF 2008-TN8447.

(b) Taxa collected in Lake Anna gill net and electrofishing samples by Dominion researchers as reported in Tables 5 and 10 of VEPCO 2021-TN8268.

(c) Recreationally important species.

Table 3-13 Fish Taxa Reported from the North Anna River, 2015–2019

Scientific Name[(a)]	Family	Common Name
Trinectes maculatus	Achiridae	hogchoker
Anguilla rostrata	Anguillidae	American eel
Aphredoderus sayanus	Aphredoderidae	pirate perch
Hypentelium nigricans	Catostomidae	northern hog sucker
Chaenobryttus gulosus	Centrarchidae	warmouth
Lepomis auratus	Centrarchidae	redbreast sunfish[(b)]
Lepomis cyanellus	Centrarchidae	green sunfish
Lepomis macrochirus	Centrarchidae	bluegill[(b)]
Lepomis microlophus	Centrarchidae	redear sunfish[(b)]
Micropterus dolomieu	Centrarchidae	smallmouth bass[(b)]
Micropterus punctulatus	Centrarchidae	spotted bass
Micropterus salmoides	Centrarchidae	largemouth bass[(b)]
Alosa aestivalis	Clupeidae	blueback herring
Campostoma anomalum	Cyprinidae	central stoneroller
Cyprinella analostana	Cyprinidae	satinfin shiner
Lythrurus ardens	Cyprinidae	rosefin shiner
Nocomis micropogon	Cyprinidae	river chub
Nocomis spp.	Cyprinidae	cyprinid species
Notemigonus crysoleucas	Cyprinidae	golden shiner
Notropis amoenus	Cyprinidae	comely shiner
Notropis hudsonius	Cyprinidae	spottail shiner
Notropis procne	Cyprinidae	swallowtail shiner
Notropis rubellus	Cyprinidae	rosyface shiner
Notropis telescopus	Cyprinidae	telescope shiner
Semotilus corporalis	Cyprinidae	fallfish
Esox niger	Esocidae	chain pickerel
Ameiurus catus	Ictaluridae	white catfish[(b)]
Ictalurus natalis	Ictaluridae	yellow bullhead
Ictalurus punctatus	Ictaluridae	channel catfish[(b)]
Noturus gyrinus	Ictaluridae	tadpole madtom
Noturus insignis	Ictaluridae	margined madtom
Etheostoma olmstedi	Percidae	tessellated darter
Etheostoma vitreum	Percidae	glassy darter
Percina notogramma	Percidae	stripeback darter
Percina peltate	Percidae	shield darter
Lethenteron appendix	Petromyzontidae	American brook lamprey
Petromyzon marinus	Petromyzontidae	sea lamprey

(a) Taxa listed in table are those collected in North Anna River electrofishing samples by Dominion researchers as reported in Tables 14 and 15 of VEPCO 2021-TN8268.
(b) Recreationally important species.

The zebra mussel is a freshwater bivalve from Russia that forms dense colonies on any hard surface, living or inanimate. Individuals will attach to boats, pipes, piers, docks, plants, clams, and even other mussels. Zebra mussels can cause significant biofouling of industrial intake pipes at power and water facilities. According to the USGS's Nonindigenous Aquatic Species Database, the zebra mussel has not been reported from the North Anna River (USGS Undated-TN8457). Dominion has also not reported the species in biological sampling of the river or reservoir (VEPCO 2021-TN8268).

3.7.3 Proposed Action

The following sections address the site-specific environmental impacts of North Anna SLR on the environmental issues identified in Table 3-1 that relate to aquatic resources.

3.7.3.1 Impingement and Entrainment of Aquatic Organisms (Plants with Once-Through Cooling Systems or Cooling Ponds)

This section evaluates the impacts of impingement and entrainment during the North Anna SLR period on aquatic organisms. In 2002, the NRC staff evaluated the impacts of the initial North Anna license renewal on aquatic organisms as two issues: "impingement of fish and shellfish" and "entrainment of fish and shellfish in early life stages." For both issues, the NRC staff determined that the impacts of continued operation of North Anna would be SMALL during the initial license renewal term (i.e., 2018–2038 for Unit 1 and 2020–2040 for Unit 2) (NRC 2002-TN665). In 2013, the NRC staff issued Revision 1 of the LR GEIS (NRC 2013-TN2654). In the revised LR GEIS, the staff combined the two aquatic issues into a single site-specific issue: "impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds)." This section evaluates this consolidated issue as it applies to continued operation of North Anna during the proposed SLR term (i.e., 2038–2058 for Unit 1, and 2040–2060 for Unit 2).

Impingement occurs when organisms are trapped against the outer part of an intake structure's screening device (79 FR 48300-TN4488). The force of the intake water traps the organisms against the screen, and individuals are unable to escape. Impingement can kill organisms immediately or cause exhaustion, suffocation, injury, and other physical stresses that contribute to later mortality. The potential for injury or death is generally related to the amount of time an organism is impinged, its fragility (susceptibility to injury), and the physical characteristics of the screen wash and fish return systems of the intake structure. The EPA has found that impingement mortality is typically less than 100 percent if the cooling water intake system includes fish return or backwash systems (79 FR 48300-TN4488). Because organisms that are not impinged are typically fish with fully formed scales and skeletal structures and well-developed survival traits, such as behavioral responses to avoid danger, many impinged organisms can survive under proper conditions (79 FR 48300-TN4488).

Entrainment occurs when organisms pass through the screening device and travel through the entire cooling system, including the pumps, condenser or heat exchanger tubes, and discharge pipes (79 FR 48300-TN4488). Organisms susceptible to entrainment are of smaller size, such as ichthyoplankton, larval stages of shellfish and other macroinvertebrates, zooplankton, and phytoplankton. During travel through the cooling system, entrained organisms experience physical trauma and stress, pressure changes, excess heat, and exposure to chemicals (Mayhew et al. 2000-TN8458). Because organisms that can be entrained generally consist of fragile life stages (e.g., eggs, which exhibit poor survival after interacting with a cooling water intake structure, and early larvae, which lack a skeletal structure and swimming ability), the EPA has concluded that, for purposes of assessing the impacts of a cooling water intake system on the aquatic environment, all entrained organisms die (79 FR 48300-TN4488).

Entrainment susceptibility is highly dependent upon life history characteristics. For example, broadcast spawners with non-adhesive, free-floating eggs that drift with water current may become entrained in a cooling water intake system. Nest-building species or species with adhesive, demersal eggs are less likely to be entrained in early life stages. Susceptibility of larval life stages to entrainment depends on body morphometrics and swimming ability.

If several life stages of a species occupy the source water, that species can be susceptible to both impingement and entrainment. For instance, adults and juveniles of a given species of fish may be impinged against the intake screens, while larvae and eggs may pass through the screening device and be entrained through the cooling system. The susceptibility to either impingement or entrainment relates to the size of the individual relative to the size of the mesh on the screening device. By definition, the EPA considers aquatic organisms that can be collected or retained on a sieve with 0.56 in. (1.4 cm) diagonal openings to be susceptible to impingement (79 FR 48300-TN4488). This equates to screen device mesh openings of ½ in. by ¼ in. (1.3 cm by 0.635 cm), which is slightly larger than the openings on the typical ⅜ in. square mesh found at many nuclear power plants. Organisms smaller than the 0.56 in. (1.4 cm) mesh are considered susceptible to entrainment.

The magnitude of impact that impingement and entrainment creates on the aquatic environment depends on nuclear power plant-specific characteristics of the cooling system as well as characteristics of the local aquatic community. Relevant nuclear power plant characteristics include location of the cooling water intake structure, intake velocities, withdrawal volumes, screening device technologies, and the presence or absence of a fish return system. Relevant characteristics of the aquatic community include species present in the environment, life history characteristics, population abundances and distributions, special species statuses and designations, and regional management objectives.

<u>North Anna Cooling Water Intake System</u>

The North Anna cooling water intake system impinges and entrains aquatic organisms as it withdraws water from Lake Anna. Section 2.1.3 of this EIS describes the North Anna cooling and auxiliary water systems in detail. Features relevant to the impingement and entrainment analysis are summarized below.

Lake Anna water first interacts with the cooling water intake structure at screen wells housed in the intake structure at the end of a cove just north of North Anna on the southwestern shore of Lake Anna. Water flows through one of two screen wells, followed by one of four intake bays. As North Anna withdraws lake water, fish and other aquatic organisms that cannot swim fast enough to escape the flow of water may be swept into the intake. Intake flow is 0.62 ft per second (fps) (0.19 m/s) as measured at each forebay approximately 16 ft (5 m) out from the trash racks (VEPCO 1986-TN8397). Thus, organisms within the source water that cannot resist or escape this flow are drawn into the intake structure along with the water.

Once within one of the intake bays, organisms encounter a steel trash rack made of 0.5 in. (3 cm)-wide by 3.5 in. (8.9 cm)-thick vertical bars placed at 4 in. (10 cm) intervals (VEPCO 2021-TN8268). The trash racks and associated mechanical rakes remove large debris for disposal. Approximately 16 ft (4.9 m) downstream from each trash rack, organisms encounter Ristroph traveling screens made of 0.125 in. (0.32 cm) by 0.5 in. (1.3 cm) 16-gauge mesh with 0.53 in. (1.34 cm) diagonal openings (VEPCO 2021-TN8268). Organisms that are too large to pass through the traveling screen mesh, such as juvenile and adult fish and shellfish, become impinged on the screens. Through-screen velocity is 2.57 fps (0.78 m/s) based on a wetted screen area of 350 square ft (ft^2) (107 m^2) and at extremely low water level and a percent of wetted screen area that is not wire mesh of 59 percent (VEPCO 2021-TN8268).

Screen wash pumps wash impinged organisms and other debris off the screens and into wire baskets for disposal. The screens are designed to rotate once every 24 hours or whenever a predetermined pressure differential exists across the screens (Dominion 2005-TN8446). However, Dominion personnel operate the screens manually on an as-needed basis. North Anna does not have a fish return system, so all impinged organisms are either collected at the trash racks or on the traveling screens and disposed of as solid waste along with other debris.

Organisms small enough to pass through the traveling screen mesh, such as fish eggs, larvae, and other zooplankton, are entrained into the cooling water system. Entrained organisms pass through the entire cooling system and reenter Lake Anna along with heated effluent at the WHTF through a single discharge canal located 200 ft (60 m) south of the intake location. Water flows from the discharge canal through a series of three lagoons before reentering the reservoir portion of the lake. During this process, entrained organisms are subject to mechanical, thermal, and toxic stresses.

Clean Water Act Section 316(b) Requirements for Existing Facilities

Section 316(b) of the CWA addresses the adverse environmental impacts caused by the intake of cooling water from waters of the United States (Federal Water Pollution Control Act of 1972-TN662). This section of the CWA grants the EPA the authority to regulate cooling water intake structures to minimize adverse impacts on the aquatic environment. Under CWA Section 316(b), the EPA has issued regulations for existing facilities, such as North Anna, at 40 CFR 122 (TN2769) and 40 CFR 125, Subpart J (TN254). Existing facilities include power generation and manufacturing facilities that are not new facilities as defined at 40 CFR 125.83 (TN254) and that withdraw more than 2 mgd of water from waters of the United States and use at least 25 percent of the water they withdraw exclusively for cooling purposes.

Under CWA Section 316(b) regulations, the location, design, construction, and capacity of cooling water intake structures of regulated facilities must reflect the best technology available (BTA) for minimizing impingement mortality and entrainment. The EPA, or authorized States and Tribes, impose BTA requirements through NPDES permitting programs. In Virginia, VDEQ administers the VPDES program and issues VPDES permits to regulated facilities.

With respect to impingement mortality, the BTA standard requires that existing facilities comply with one of the following seven alternatives (40 CFR 125.94(c)TN254):

1. operate a closed-cycle recirculating system as defined at 40 CFR 125.92 (subsequently referred to in this EIS as “Compliance Alternative 1”) (40 CFR Part 125-TN254)
2. operate a cooling water intake structure that has a maximum through-screen design intake velocity of 0.5 fps (0.15 m/s)
3. operate a cooling water intake structure that has a maximum through-screen intake velocity of 0.5 fps (0.15 m/s)
4. operate an offshore velocity cap as defined at 40 CFR 125.92 that is installed before October 14, 2014 (TN254)
5. operate a modified traveling screen that the NPDES Permit Director determines meets the definition at 40 CFR 125.92(s) and that the NPDES Permit Director determines is the BTA for impingement reduction (TN254)

6. operate any other combination of technologies, management practices, and operational measures that the NPDES Permit Director determines is the BTA for impingement reduction
7. achieve the specified impingement mortality performance standard.

Options (1), (2), and (4) above are essentially preapproved technologies requiring no demonstration or only a minimal demonstration that the flow reduction and control measures are functioning as the EPA envisioned. Options (3), (5), and (6) require that more detailed information be submitted to the permitting authority before the permitting authority may specify it as BTA for a given facility. The permitting authority may also review site-specific data and conclude that a de minimis rate of impingement exists and, therefore, no additional controls are warranted to meet the BTA impingement mortality standard.

With respect to entrainment, the CWA Section 316(b) regulations do not prescribe a single nationally applicable entrainment performance standard because the EPA did not identify a technology for reducing entrainment that is effective, widely available, feasible, and does not lead to unacceptable non-water quality impacts (79 FR 48300-TN4488). Instead, the permitting authority must establish the BTA entrainment requirement for each facility on a site-specific basis. In establishing site-specific requirements, the regulations direct the permitting authority to consider the following factors (40 CFR 125.98(f)(2) TN254):

1. numbers and types of organisms entrained, including, specifically, the numbers and species (or lowest taxonomic classification possible) of federally listed, threatened and endangered species, and designated critical habitat (e.g., prey base)
2. impact of changes in particulate emissions or other pollutants associated with entrainment technologies
3. land availability inasmuch as it relates to the feasibility of entrainment technology
4. remaining useful plant life
5. quantified and qualitative social benefits and costs of available entrainment technologies when such information on both benefits and costs is of sufficient rigor to make a decision.

In support of entrainment BTA determinations, facilities must conduct site-specific studies and provide data to the permitting authority to aid in its determination of whether site-specific controls would be required to reduce entrainment and which controls, if any, would be necessary.

Analysis Approach

When available, the NRC staff relies on the expertise and authority of the NPDES permitting authority with respect to the impacts of impingement and entrainment. Therefore, if the NPDES permitting authority has made BTA determinations for a facility under CWA Section 316(b) in accordance with the current regulations at 40 CFR Part 122 and 40 CFR Part 125, which were issued in 2014 (79 FR 48300-TN4488), and that facility has implemented any associated requirements, the NRC staff assumes that adverse impacts on the aquatic environment will be minimized. In such cases, the NRC staff concludes that the impacts of either impingement, entrainment, or both would be SMALL for the proposed license renewal term.

In cases where the NPDES permitting authority has not made BTA determinations, the NRC staff analyzes the potential impacts of impingement, entrainment, or both, using a weight of evidence approach. In such an approach, the staff considers multiple lines of evidence to assess the presence or absence of ecological impairment (i.e., noticeable or detectable impact) on the aquatic environment. For instance, as its lines of evidence, the staff might consider the cooling water intake system design, the results of impingement and entrainment studies performed at the facility, and trends in fish and shellfish population abundance indices. The staff then considers these lines of evidence together to predict the level of impact (SMALL, MODERATE, or LARGE) that the aquatic environment is likely to experience over the course of the proposed license renewal term.

Baseline Condition of the Resource

For the purposes of its impingement and entrainment analysis, the NRC staff assumes that the baseline condition of the resource is the Lake Anna aquatic community as it occurs today. The current community is a combination of species that were present during initial impoundment and those that have been stocked for recreational purposes. All fish and benthic invertebrate populations are self-sustaining with the exception of striped bass, which VDGIF continues to stock annually. Recent sampling indicates no major upward or downward trends in juvenile or adult fish populations. While species richness, evenness, and diversity within the community may change or shift between now and when the proposed SLR period would begin, the NRC staff finds the aquatic community as it occurs today to be a reasonable surrogate in the absence of fishery and species-specific projections.

3.7.3.1.1 *Impingement*

Impingement Area of Influence

In connection with Dominion's 40 CFR 122.21(r) submittal to VDEQ, HDR (VEPCO 2021-TN8268) calculated the North Anna impingement area of influence (AOI). The impingement AOI is the area encompassed by the 0.5-fps (0.15-m/s) velocity contour at the cooling water intake system. At this boundary and beyond it, the potential for impingement is approximately zero. Within this boundary, the potential increases with increasing proximity to the intake. Organisms within the AOI have a high probability of being impinged, but actual entrainment will be the product of physical and biological factors that vary over space, time, and species. For instance, because juvenile and adult fish have differing swimming abilities and differing preferred habitats, including those that involve natural water velocities above 0.5 fps (0.15 m/s), a particular organism within the 0.5-fps (0.15-m/s) velocity contour will vary in susceptibility to impingement.

HDR (VEPCO 2021-TN8268) calculated the impingement AOI to be represented as a quarter circle area originating at the center of the cooling water intake structure with a radius of 211 ft (64 m), based on the velocity thresholds of 0.5 fps (0.15 m/s). The calculated AOI equates to a surface area of 35,000 ft^2 (0.8 ac; 0.3 ha) over which organisms may be susceptible to impingement. This represents an extremely small portion of Lake Anna (less than 0.001 percent of the lake's total surface area). This AOI would remain the same during the proposed license renewal term. The AOI is considered further below as one component affecting the NRC staff's conclusion on entrainment.

Impingement Mortality BTA

In 2017, VDEQ, in consultation with the EPA, agreed with Dominion's determination that North Anna meets the administrative criteria of a closed-cycle recirculating system consistent with the definition in 40 CFR 125.92(c)(2) (VEPCO 2020-TN8099; VEPCO 2021-TN8268). Under the regulatory definition, a closed-cycle recirculating system is one that passes cooling water through the condenser and other components of the cooling system and reuses the water for cooling multiple times. Such a system can include impoundments of waters of the United States where the impoundment was constructed before October 1, 2014, and was created for the purpose of serving as part of the cooling water system.

Lake Anna was created by impounding the North Anna River to use as a cooling water source for surface condensers and other heat exchanger equipment at North Anna. Accordingly, North Anna is eligible to meet the impingement mortality reduction standard through Compliance Alternative 1 (40 CFR 125.94(c)(1) -TN254) described previously in this section. In Dominion's 2018 VPDES permit renewal application to VDEQ, Dominion confirmed that it has selected this method for North Anna compliance with the impingement mortality BTA standard specified in 40 CFR 122.21(r)(6) (VEPCO 2021-TN8268). VDEQ is currently reviewing Dominion's application. As one component of its review, VDEQ will make a final determination regarding its agreement with Dominion's chosen method.

Impingement Conclusion

Because Compliance Alternative 1 is a preapproved alternative under CWA Section 316(b) regulations, and because the EPA and the VDEQ have confirmed that North Anna meets the criteria for a closed-cycle recirculating system for purposes of CWA Section 316(b) compliance, the NRC staff finds that the adverse impacts on the aquatic environment associated with impingement are minimized. Further, the impingement AOI is an extremely small percentage of Lake Anna (less than 0.001 percent of the lake's total surface area). Collectively, this information indicates that impingement is unlikely to cause noticeable or detectable impacts on Lake Anna's aquatic populations. Accordingly, the NRC staff finds that the impacts of impingement during the proposed SLR term would neither destabilize nor noticeably alter any important attribute of the aquatic environment and would, therefore, result in SMALL impacts on aquatic resources.

3.7.3.1.2 *Entrainment*

Entrainment BTA

The VDEQ has not made an entrainment BTA determination for North Anna. It will make that determination as one component of issuing a renewed VPDES permit following its review of Dominion's 2018 renewal application. When VDEQ makes its BTA determination, it may (or may not) impose additional requirements to reduce or mitigate the effects of entrainment at North Anna. Such requirements would be incorporated as conditions of the renewed VDPES permit, which would be issued and take effect before the renewed operating license period. The NRC staff assumes that any additional requirements that VDEQ may impose would minimize the impacts of entrainment over the course of the proposed license renewal term, in accordance with CWA Section 316(b) requirements.

Because VDEQ's entrainment BTA determination is currently pending, the NRC staff considers other lines of evidence below to evaluate the magnitude of impact that entrainment would likely represent during the proposed SLR period of operation. In its analysis, the NRC staff considers results of entrainment studies, entrainment reduction methods, and entrainment AOI.

Entrainment Studies

Two entrainment studies have been undertaken at North Anna. VEPCO conducted the first study from 1978–1983, and HDR Engineering, Inc. conducted the second study from 2016 to 2017. This section summarizes the results of each study.

Entrainment Sampling, 1978–1983

From 1978 through 1983, VEPCO conducted weekly entrainment sampling at the North Anna cooling water intake from March through July of each year. Researchers gathered ichthyoplankton samples with 505-μm mesh conical plankton nets equipped with flowmeters at near-surface, mid-depth, and near-bottom depths in front of the North Anna intake forebay. Ten-minute tows were gathered four times per sample day. All samples were collected and preserved and then later processed in a laboratory for identification, enumeration, and further analysis. A 1985 CWA Section 316(b) demonstration report (VEPCO 1986-TN8397) shows the results of this effort. The information in this section is summarized from that report unless otherwise indicated.

VEPCO collected a total of 7,908 organisms of seven distinct taxa in its entrainment samples. All collected ichthyoplankton were larvae; no fish eggs were collected in any samples. VEPCO attributed this to the fact that most species of fish in Lake Anna produce demersal, adhesive eggs that are unlikely to occur in the water column, where they would be susceptible to entrainment. VEPCO also did not collect any early life stages of shellfish in its samples.

Gizzard shad was the most abundantly collected species over all sample years. It accounted for 65.7 percent of collections. White perch (16.7 percent), sunfishes (13.4 percent), yellow perch (4.9 percent), and black crappie (1.0 percent) were the next most abundant taxa. Channel catfish and largemouth bass were each represented by the collection of a single individual. Sunfishes and yellow perch were more prevalent in the first year than in following years, whereas white perch numbers generally increased over the study period.

During the study, yellow perch were typically the first species to appear in each year’s collections. Larvae of this species appeared in late March to early April when water temperatures approached 12°C (54°F). White perch appeared in mid-April when water temperatures approached 14°C (57°F), and the species peaked in mid-May. Gizzard shad appeared in late April to early May at water temperatures of 14–18°C (57–64°F), and the species peaked in early June. Sunfishes appeared last in May to June, when temperatures rose to at least 19°C (66°F). Both gizzard shad and sunfishes were collected in low numbers in July.

Larvae were most abundant during midnight collections; 43 percent of larvae were collected during the 2,400-hour sample for all years and sampling events. Gizzard shad and white perch were most common during the midnight collections. Sunfishes were more frequently collected during daylight hours, and yellow perch abundance fluctuated during sample intervals.

In terms of depth, sunfishes, yellow perch, and black crappie were collected primarily at the surface; gizzard shad were collected primarily from middle and bottom depths; white perch were generally evenly distributed among the depths. Over all species and collection years, the percentage of larvae was roughly even among the three collection depths.

VEPCO used the results of entrainment sampling to calculate percent cropping, the reduction in adult recruitment caused by entrainment, for each species, assuming 100 percent mortality of entrained larvae (see Table 3-14). Cropping was below 1 percent for all species. Based on its analysis, VEPCO concluded that the reduction in adult recruitment attributable to entrainment at North Anna is well below values reported in scientific literature to cause significant impact on fishery or individual populations. For instance, numerical losses of 5.48 percent of the standing crop of gizzard shad, 15.3 percent of the standing crop of white and yellow bass (combined), and 0.59 percent of sunfishes on Lake Sangchris in Illinois did not result in observable adverse effects on the sport fishery of that lake (Porak and Tranquilli 1981-TN9072). VEPCO concluded that the species that experience entrainment have sufficient capacity within their populations to offset the associated losses.

Table 3-14 Mean Entrainment Equivalent Adults by Species, 1978–1983

Species	Mean No. Larvae Entrained (in millions)	Mean No. Equivalent Adults	Mean Total Standing Crop (in millions)	Mean Percent Cropping
Black crappie	41.0	63,375	2.3	0.85
White perch	23.0	12,964	1.5	0.66
Yellow perch	20.0	6,249	1.7	0.46
Gizzard shad	80.0	15,080	7.7	0.23
Sunfishes	21.0	11,289	33.0	0.04

VEPCO 1986-TN8397.

Entrainment Sampling, 2016–2017

From April through September 2016 (Year 1) and March through September 2017 (Year 2), HDR conducted bimonthly entrainment sampling at North Anna. Researchers gathered ichthyoplankton samples with 335-µm mesh hoop nets used to filter approximately 330 ft^3 (100 m^3) of intake water pumped through a 4-in. (10-cm) polyvinyl chloride pipe opening at each of three depths (near-surface, mid-depth, and near-bottom depths) along the front of the Unit 2 bar racks. One-hundred-minute tows were gathered four times per sample day for a total of 288 samples during the study period. All samples were collected and preserved and then later processed in a laboratory for identification, enumeration, and further analysis. Results of this effort are reported in a 2018 entrainment characterization study report (VEPCO 2021-TN8268). The information in this section is summarized from that report unless otherwise indicated.

HDR collected a total of 1,781 organisms of 13 distinct taxa in its entrainment samples. All organisms were finfish. Taxonomic diversity was low (see Table 3-15). The number of distinct taxa ranged from a monthly low of one in September of each year to a high of seven in May 2016. The most taxonomically rich samples were collected in spring: April (five taxa in each year) and May (seven taxa in Year 1 and five taxa in Year 2). Overall, herrings and shad combined (Clupeidae), threadfin/gizzard shad (*Dorsoma* spp.; including the distinct taxa gizzard shad and threadfin shad), and sunfishes (*Lepomis* spp.) dominated collections.

With respect to life stages, post-yolk-sac larvae (PYSL) dominated collections. PYSL accounted for 83 percent of collected organisms in Year 1 samples and 96 percent of collected organisms in Year 2 samples. Yolk-sac larvae (YSL) comprised 6 percent of Year 1 collections and 2 percent of Year 2 collections. Very few juveniles or adult fish appeared in samples, and all eggs were nonviable (e.g., unfertilized, dead, or decaying). Collectively, these three life stages accounted for 5 percent or less.

Table 3-15 Total Number of Fish Collected in Entrainment Samples by Taxa and Life Stage, 2016–2017

Taxa[(a)]	Life Stage[(b)]	Year 1[(c)] Total Number	Year 1[(c)] Percent	Year 2[(d)] Total Number	Year 2[(d)] Percent
herrings and shad	PYSL	191	36.6	519	68.3
common sunfishes	PYSL	172	33.0	65	8.6
white perch	PYSL	23	4.4	14	1.8
herrings and shad	UIDL	19	3.6	3	0.4
threadfin/gizzard shad	PYSL	15	2.9	98	12.9
herrings and shad	YSL	14	2.7	1	0.1
largemouth bass	Juv	11	2.1	3	0.4
unidentified finfish	UIDL	10	1.9	5	0.7
gizzard shad	YSL	9	1.7	1	0.1
gizzard shad	PYSL	7	1.3	1	0.1
threadfin shad	PYSL	7	1.3	18	2.4
channel catfish	PYSL	6	1.1	4	0.5
blueback herring	Juv	5	1.0	–	–
Bluegill	Juv	5	1.0	1	0.1
common sunfishes	Juv	5	1.0	–	–
yellow perch	YSL	5	1.0	4	0.5
Crappie	PYSL	4	0.8	–	–
Sunfish	PYSL	4	0.8	–	–
white perch	YSL	3	0.6	4	0.5
Darters	PYSL	2	0.4	–	–
golden shiner	PYSL	1	0.2	–	–
herrings and shad	egg	1	0.2	5	0.7
largemouth bass	PYSL	1	0.2	–	–
Minnow	PYSL	1	0.2	3	0.4
white catfish	PYSL	1	0.2	–	–
blueback herring	Adult	–	–	1	0.1
blueback herring	PYSL	–	–	2	0.3
Darters	YSL	–	–	2	0.3
gizzard shad	Juv	–	–	1	0.1
spottail shiner	PYSL	–	–	1	0.1
threadfin shad	Juv	–	–	1	0.1
yellow perch	PYSL	–	–	3	0.4
TOTAL	**n/a**	**522**	**100.0**	**760**	**100.0**

n/a= not applicable; – = data nor available.
(a) Presented in order of abundance in Year 1 collections.
(b) Juv = juvenile; UIDL = unidentified life stage; PYSL = post-yolk-sac larvae; YSL = yolk-sac larvae.
(c) April–September 2016.
(d) March–September 2017.
Source: VEPCO 2021-TN8268, Table 9-4.

Table 3-15 presents the total number of organisms collected by taxa and life stage for the 2 years of sampling. During Year 1, PYSL of herrings and shad (37 percent) and sunfishes (33 percent) were the most abundantly collected life stage and taxa. Threadfin/gizzard shad PYSL (3 percent) and herrings and shad YSL (3 percent) were collected in low abundances. The remaining taxa accounted for 2 percent or less of the total collections. In Year 2, PYSL of herrings and shad (68 percent), threadfin/gizzard shad (13 percent), and sunfishes (9 percent) were the most abundant life stage and taxa. PYSL of threadfin/gizzard shad (13 percent) and threadfin shad (2 percent) were collected in relatively higher abundance than the first year. White perch PYSL (2 percent), herrings and shad of unidentified life stage larvae (less than 1 percent), and herrings and shad YSL (less than 1 percent) were collected in relatively low abundance during the second year compared to the first year. The remaining taxa accounted for 1 percent or less of the total collection. No federally or State-protected species were collected in any samples in either year.

HDR evaluated entrainment densities by sample depth strata (i.e., near-surface, mid-depth, and near-bottom). Although collection densities varied by year, taxa, and month, overall, mid-depth and near-bottom samples accounted for the majority of entrained organisms. During both sampling years, slightly more organisms were collected at mid-depth (48 percent in 2016 and 56 percent in 2017) than near-bottom (46 percent in 2016 and 33 percent in 2017). Nearly all taxa and life stages appeared at all three depths with no consistent trends.

With respect to diel variation, entrainment densities were higher at night (2,200 hours) during Year 1 and similarly higher in late afternoon (1,600 hours) and at night (2,200 hours) during Year 2. Diel patterns did not exhibit a clear relationship to depth strata, although HDR postulated that organisms appeared to move from the bottom during nighttime to mid-depth during daylight.

With respect to seasonal variation, samples contained the highest densities of organisms in May, June, and July. These samples consisted primarily of herring and shad PYSL (May to July), sunfishes (June and July and extending into August in Year 1), and threadfin/gizzard shad (May to June in Year 2). March, April, and September samples exhibited the lowest densities.

HDR used sample results and actual intake flows[3] to estimate year-specific total entrainment for each entrained species and life stage. Table 3-16 presents taxon-specific estimated annual entrainment for each sampling year. HDR estimated annual baseline entrainment during Year 1 to be 53,593,333 finfish and 67,924,622 finfish under actual intake flows and design flows, respectively. During Year 2, HDR estimated annual baseline entrainment to be 83,421,119 finfish and 99,782,529 finfish under actual intake flows and design flows, respectively. Because no shellfish were collected during the study, estimated annual shellfish entrainment was zero.

HDR also used the study data to estimate monthly and annual entrainment abundances for a typical season (March through September) (see Table 3-17). Of the projected 68,565,980 entrained fish per season, HDR estimated larvae of threadfin shad (43 percent), gizzard shad (28 percent), and bluegill (20 percent) to be the most abundantly entrained life stage and species (VEPCO 2021-TN8268). Monthly entrainment abundance was highest in July and lowest in September.

Overall, HDR found that the results of its 2016-2017 study compared well with the 1978–1983 entrainment study. In both studies, gizzard shad, white perch, and sunfishes were the dominant taxa. Both studies reported peak herring, shad, and white perch densities in spring months followed by sunfishes in summer months. Blueback herring and threadfin shad were not available for collection in the earlier study because these species were introduced to Lake Anna in the 1980s. The earlier study collected no fish eggs, which it attributed to the dominance of species

[3] As defined by the 2014 final CWA Section 316(b) rule (79 FR 48300-TN4488), the actual intake flow is defined as the average volume of water withdrawn by the cooling water intake system over the previous three years (2015–2017).

with demersal, adhesive eggs. This is consistent with the later study. HDR did not draw any overall conclusions with respect to the impacts of entrainment on Lake Anna finfish populations.

Table 3-16 Estimated Annual Entrainment Based on Year-Specific Densities with Sampling Year-Specific Flows and CWA-Defined Actual Intake Flows, 2016–2017

Taxa[(a)]	Life Stage[(b)]	Year 1[(c)] Year-Specific Flows	Year 1[(c)] CWA-Defined Actual Intake Flow	Year 2[(d)] Year-Specific Flows	Year 2[(d)] CWA-Defined Actual Intake Flow
herrings and shad	PYSL	20,276,410	20,642,505	57,056,877	56,066,514
common sunfishes	PYSL	18,576,046	19,019,503	7,290,097	7,222,922
white perch	PYSL	1,833,833	1,971,714	1,342,639	1,155,013
herrings and shad	UIDL	1,767,519	1,830,032	310,189	296,406
threadfin/gizzard shad	PYSL	1,620,776	1,653,221	11,153,969	11,011,082
herrings and shad	YSL	1,235,293	1,297,914	107,494	107,662
largemouth bass	Juv	1,130,569	1,133,726	322,916	321,280
gizzard shad	YSL	937,037	945,083	107,943	108,112
unidentified finfish	UIDL	922,339	954,354	511,562	479,885
threadfin shad	PYSL	769,285	784,991	2,062,885	2,037,833
gizzard shad	PYSL	750,834	766,959	114,673	113,280
channel catfish	Juv	657,642	673,865	458,461	452,336
common sunfishes	YSL	536,828	550,571	–	–
blueback herring	Juv	529,870	530,284	–	–
sunfish	PYSL	424,748	432,138	–	–
crappie	PYSL	383,429	391,252	–	–
yellow perch	YSL	352,685	389,999	368,159	276,193
white perch	YSL	216,976	239,933	376,372	301,291
darters	PYSL	213,696	213,864	–	–
white catfish	PYSL	111,407	113,644	–	–
herrings and shad	Egg	108,097	108,181	536,756	537,595
largemouth bass	PYSL	100,376	100,454	–	–
minnow	PYSL	71,631	79,210	331,503	325,597
golden shiner	PYSL	66,007	72,991	–	–
blueback herring	PYSL	–	–	188,656	160,408
darters	YSL	–	–	190,379	161,874
gizzard shad	Juv	–	–	114,781	113,387
spottail shiner	PYSL	–	–	89,595	76,180
threadfin shad	Juv	–	–	114,933	113,537
yellow perch	PYSL	–	–	270,280	173,530
TOTAL	**n/a**	**53,593,333**	**54,896,388**	**83,421,119**	**81,611,917**

n/a= not applicable; – = data nor available.
(a) Presented in order of estimated Year 1 year-specific flow entrainment abundance.
(b) Juv = juvenile; UIDL = unidentified life stage; PYSL = post-yolk-sac larvae; YSL = yolk-sac larvae.
(c) April–September 2016.
(d) March–September 2017.
Source: VEPCO 2021-TN8268, Table 9-7.

Table 3-17 Average Monthly and Annual Entrainment Abundance Estimates by Taxa and Life Stage

Species[a]	Life Stage	Estimated No. of Organisms Entrained[b]							Total No.	% of Total
		March	April	May	Jun	July	August	September		
threadfin shad	larvae	–	–	–	8,408,464	20,598,529	277,649	–	**29,284,642**	**42.7**
gizzard shad	larvae	–	1,224,817	12,226,671	2,703,674	2,606,352	113,991	–	18,875,505	27.5
bluegill	larvae	–	–	1,147,544	4,446,438	3,709,910	3,906,478	251,729	13,462,099	19.6
white perch	larvae	183,465	1,365,580	439,906	–	–	–	–	1,988,951	2.9
blueback herring	larvae	123,688	1,165,299	–	–	–	–	–	1,288,987	1.9
largemouth bass	YOY	–	–	619,908	107,596	–	–	–	727,504	1.1
yellow perch	larvae	316,554	286,387	–	–	–	–	–	602,941	0.9
channel catfish	larvae	–	–	–	–	226,601	336,500	–	563,101	0.8
gizzard shad	egg	–	–	322,888	–	–	–	–	322,888	0.5
bluegill	YOY	–	–	–	–	–	275,286	–	275,286	0.4
blueback herring	YOY	–	–	265,142	–	–	–	–	265,142	0.4
black crappie	larvae	–	41,653	170,511	–	–	–	–	212,164	0.3
spottail shiner	larvae	–	38,090	–	162,799	–	–	–	200,889	0.3
tessellated darter	larvae	–	80,937	109,731	–	–	–	–	190,668	0.3
golden shiner	larvae	–	80,036	–	–	–	–	–	80,036	0.1
white catfish	larvae	–	–	–	–	56,822	–	–	56,822	0.1
threadfin shad	YOY	–	–	–	–	56,769	–	–	56,769	0.1
gizzard shad	YOY	–	–	–	–	56,694	–	–	56,694	0.1
largemouth bass	larvae	–	–	54,892	–	–	–	–	54,892	0.1
TOTAL	n/a	623,707	4,282,799	15,357,193	15,828,971	27,311,677	4,909,904	251,729	68,565,980	100.0

Notes: YOY = young-of-year, n/a = not applicable.
(a) Presented in order of abundance.
(b) Estimated number of organisms entrained based on 3 years of actual intake flow (2015–2017) and actual mean entrainable ichthyoplankton densities from pump samples collected during April through September 2016.
Source: VEPCO 2021-TN8268, Table 3-18.

Synthesis of Entrainment Study Results

The above-described entrainment studies support several important conclusions about entrainment. First, shellfish do not appear to be susceptible to entrainment at North Anna. Neither the 1978–1983 study nor the 2016–2017 study collected early life stages of any shellfish. Second, eggs of finfish do not appear to be susceptible to entrainment at North Anna because the fish that inhabit lake Anna produce adhesive, demersal eggs that do not occur in the water column where they would be subject to the flow of the North Anna intake.

PYSL of finfish are susceptible to entrainment and accounted for the majority of entrainment study collections over both study periods. Herrings, shads, and sunfishes are the most prevalently entrained species. To a lesser extent, perches are also entrained. Entrainment of all other taxa is minimal.

This line of evidence alone, however, does not provide a complete enough picture for the NRC staff to evaluate whether entrainment is measurably affecting these species' populations. Table 3-15, Table 3-16, and Table 3-17 show year-by-year data and annual and monthly estimates. There are not enough sequential sampling years, however, to reliably ascertain a trend in entrainment impacts on the species' populations. The potential effects of entrainment on these taxa are further evaluated under "Finfish Monitoring Trends" below.

<u>Entrainment Area of Influence</u>

In connection with Dominion's 40 CFR 122.21(r) submittal to VDEQ, HDR (2021-TN8268) calculated the North Anna entrainment AOI. The entrainment AOI is the area within which plankton may be drawn into the intake rather than transported away in the ambient flow. For an organism to become entrained, it must enter the entrainment AOI of the cooling water intake system. Organisms within the AOI have a high probability of being withdrawn by the intake, but not all organisms within the AOI will be entrained. Actual entrainment will be the product of physical and biological factors that vary over space, time, and species. Physical and temporal factors that influence the AOI include the following (VEPCO 2021-TN8268):

- speed, direction, and distribution of flow in the waters that surround the cooling water intake structure
- bathymetry of the surrounding waters
- intake flow rate and variability of flow to the intake
- design of the intake

HDR (2021-TN8268) calculated the entrainment AOI based on velocity thresholds of 0.3 fps (0.09 m/s) and 0.1 fps (0.03 m/s). These velocities represent the upper and lower intake-induced velocities and are consistent with the velocities used in other AOI studies for similar lake environments. HDR found the entrainment AOI to be represented as a quarter circle area originating at the center of the cooling water intake structure with a radius of 351 ft (107 m) to 1,054 ft (321 m), based on the velocity thresholds of 0.3 fps (0.09 m/s) or 0.1 fps (0.03 m/s), respectively. At locations where the intake-induced velocity is lower, the ambient wind-induced currents likely determine the flow patterns and, thus, the movement of nonmotile and limited mobility organisms within the water column.

The calculated AOI equates to a surface area of 872,500 ft^2 (20 ac [8 ha]) over which organisms may experience the draw of the North Anna intake current. This represents an extremely small portion of Lake Anna (less than 0.1 percent of the lake's total surface area). This AOI would remain the same during the proposed license renewal term.

Finfish Monitoring Trends

Dominion and VDGIF perform aquatic sampling to monitor the health of Lake Anna finfish populations. Dominion has conducted quarterly gill net and electrofishing sampling of Lake Anna since 1987, and VDGIF performs periodic sampling to support management of the reservoir's fisheries and inform future stocking of recreationally important finfish species. Section 3.7.1.1 of this EIS describes these sampling efforts and associated results.

As established previously in this section under "Entrainment Studies," the taxa and life stages most susceptible to entrainment are PYSL of herrings, shads, and sunfishes, and to a lesser extent, perches. Gillnet CPUEs for shads (gizzard and threadfin) during Dominion sampling of Lake Anna indicate a cyclical pattern with high annual variability. Electrofishing CPUEs of sunfishes (bluegill, green sunfish, redbreast sunfish, and redear sunfish) have exhibited high variation over time but appear to oscillate over distinct averages. All other taxa have exhibited relatively stable CPUEs in gillnet and electrofishing samples. Those with year-to-year fluctuations have not exhibited any consistent upward or downward trends. Overall, both Dominion and VDGIF sampling results indicate that Lake Anna contains a relatively diverse assemblage of freshwater finfish, including many recreationally important species.

This line of evidence indicates that the level of entrainment of finfish into the North Anna cooling water intake system is not causing noticeable or detectable impacts on Lake Anna's aquatic populations. Because water withdrawals, and the associated risk of entrainment, would remain the same under the proposed action, the NRC staff anticipates similar (i.e., nondetectable) effects during the proposed SLR period.

Entrainment Reduction Methods

As explained previously, the CWA Section 316(b) regulations direct the permitting authority to establish BTA entrainment requirements for each facility on a site-specific basis. For North Anna, VDEQ will make that determination as one component of issuing a renewed VPDES permit. As part of its VPDES permit renewal application, Dominion considered two methods to reduce entrainment: (1) seasonal flow reductions and (2) installation of 2-mm fine-mesh screens.

Under the seasonal flow reduction method, Dominion would reduce intake flow by 21.875 percent in May and June of each year. Such an operational change would result in an overall entrainment reduction of 9.9 percent annually for an estimated total entrainment of 61,744,007 finfish per year (VEPCO 2021-TN8268). Under this scenario, entrainment of largemouth bass larvae and YOY would decrease by 22 percent and entrainment of black crappie larvae would decrease by 18 percent (see Table 3-20 in VEPCO 2021-TN8268). Both of these species are recreationally important game fish in Lake Anna, and thus, these reductions could be valuable to the recreational fishery.

Under the fine-mesh screen method, Dominion would install and operate 2 mm (0.08 in.) fine-mesh screens, which would replace the current Ristroph traveling screens, which are made of 0.125 in. (0.32 cm) by 0.5 in. (1.3 cm) 16-gauge mesh with 0.53 in. (1.34 cm) diagonal openings. Enercon et al. (TN8268) estimated that the through-screen velocity for such screens would be 1.44 fps (0.44 m/s) at the design intake flow, assuming the screens are

100 percent clean. This method would reduce entrainment by 8.7 percent to an estimated total entrainment of 62,591,613 finfish each year. Under this scenario, largemouth bass larvae and YOY entrainment would decrease by 77 and 82 percent, respectively; channel catfish and white catfish larvae entrainment would decrease by 88 percent; bluegill YOY entrainment would decrease by 77 percent, and black crappie larvae entrainment would decrease by 1.5 percent (see Table 3-30 in VEPCO 2021-TN8268). All of these species are recreationally important game fish in Lake Anna, and thus, these reductions could be valuable to the recreational fishery.

Dominion has not instituted either of these entrainment reduction methods at North Anna. As indicated previously, VDEQ is currently reviewing Dominion’s VDPES permit renewal application. VDEQ could require Dominion to implement these or other methods as BTA for entrainment. However, VDEQ will not make such a determination until it completes its review. Accordingly, the NRC staff is presently unable to predict what VDEQ might require as an outcome of that process.

<u>Entrainment Conclusion</u>

Entrainment studies indicate that finfish eggs and shellfish (all life stages) are not susceptible to entrainment at North Anna. PYSL of herrings, shads, and sunfishes, and to a lesser extent, perches, are the most susceptible life stage and taxa. Finfish monitoring trends indicate no consistent upward or downward trends in these taxa’s populations over several decades of monitoring (see Section 3.7.1.2). Further, the entrainment AOI is an extremely small percentage of Lake Anna (less than 0.1 percent of the lake’s total surface area). Collectively, this information indicates that entrainment is unlikely to be causing noticeable or detectable impacts on Lake Anna’s aquatic populations.

Because water withdrawals, and the associated risk of entrainment, would remain the same under the proposed action, the NRC staff anticipates similar (i.e., nondetectable) effects during the proposed SLR period. Further, VDEQ will make an entrainment BTA determination as part of issuing a renewed VDPES permit, which would be issued and take effect before the renewed operating license period. If VDEQ imposes any additional requirements beyond those contained in the current permit, those requirements would likely further reduce the impacts of entrainment over the course of the proposed SLR term, in accordance with CWA Section 316(b) requirements. For instance, if VDEQ requires Dominion to institute seasonal flow reductions or fine-mesh screens, such as those described under “Entrainment Reduction Methods,” the impacts of entrainment would be reduced from current levels. The NRC staff assumes that any additional requirements that VDEQ imposes would further reduce the impacts of entrainment over the course of the proposed SLR term.

For the reasons described above, the NRC staff finds that the impacts of entrainment of aquatic organisms resulting from the proposed SLR of North Anna would be SMALL.

3.7.3.1.3 *Impingement and Entrainment Conclusion*

For the reasons summarized above under “Impingement Conclusion” and “Entrainment Conclusion,” the NRC staff concludes that the impacts of impingement and entrainment on aquatic organisms resulting from the proposed SLR of North Anna would be SMALL.

3.7.3.2 Entrainment of Phytoplankton and Zooplankton (All Plants)

This issue concerns entrainment of phytoplankton and zooplankton from cooling water withdrawal. Entrainment occurs when organisms pass through the cooling system's screening device and travel through the entire system, including the pumps, condenser or heat exchanger tubes, and discharge pipes (79 FR 48300-TN4488). Organisms susceptible to entrainment are of smaller size, such as ichthyoplankton, meriplankton, zooplankton, and phytoplankton. During travel through the cooling system, entrained organisms experience physical trauma and stress, pressure changes, excess heat, and exposure to chemicals (Mayhew et al. 2000-TN8458). Because organisms that can be entrained generally consist of fragile life stages (e.g., eggs, which exhibit poor survival after interacting with a cooling water intake structure, and early larvae, which lack a skeletal structure and swimming ability), the EPA has concluded that for purposes of assessing the impacts of a cooling water intake system on the aquatic environment, all entrained organisms die (79 FR 48300-TN4488). The NRC staff assesses the site-specific impacts of entrainment of fish and shellfish during the North Anna SLR term in Section 3.6.3.1 of this EIS. This issue concerns entrainment of phytoplankton and zooplankton.

Most nuclear power plants were required to monitor for entrainment effects during the initial years of operation. The effects of entrainment on phytoplankton and zooplankton are of small significance if monitoring indicates no evidence that nuclear power plant operation has reduced or otherwise affected populations of these organisms in the source water body. The 2013 LR GEIS (NRC 2013-TN2654) summarizes the results of entrainment monitoring at several nuclear power plants. The 1996 LR GEIS (NRC 1996-TN288) and 2013 LR GEIS (NRC 2013-TN2654) concluded that nuclear power plants had not noticeably altered phytoplankton or zooplankton abundance near these and other plants and that the impacts of initial license renewal would be similar and SMALL. In the North Anna license renewal final supplemental environmental impact statement (NRC 2002-TN665), the NRC staff found no new and significant information concerning this issue, and the NRC staff adopted the 1996 LR GEIS's conclusion of SMALL for North Anna initial license renewal. Below, the NRC staff analyzes this issue site specifically for the SLR term, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN8272).

Aquatic organisms inhabiting Lake Anna may be entrained when water is drawn from Lake Anna into the North Anna intake structure. Lake Anna water first interacts with the cooling water intake structure at screen wells housed in the intake structure at the end of a cove just north of North Anna on the southwestern shore of Lake Anna. Water flows through one of two screen wells, followed by one of four intake bays. As North Anna withdraws lake water, fish and other aquatic organisms that cannot swim fast enough to escape the flow of water may be swept into the intake. Intake flow is 0.62 ft per second (fps) (0.19 m/s) as measured at each forebay approximately 16 ft (5 m) out from the trash racks (VEPCO 1986-TN8397). Thus, organisms within the source water that cannot resist or escape this flow are drawn into the intake structure along with the water.

In the mid-1980s, researchers conducted field studies to characterize the phytoplankton and zooplankton in Lake Anna. Section 3.7.1.1 summarizes the results of these studies. Table E3.7-1 in the ER (VEPCO 2020-TN8099) lists all zooplankton taxa collected in Lake Anna during sampling from 1978–1985. Although Dominion has conducted entrainment studies at North Anna, these studies only considered ichthyoplankton and not phytoplankton or zooplankton. In the absence of specific studies, the NRC staff considers entrainment AOI and results of finfish monitoring to characterize the effects of entrainment on phytoplankton and zooplankton in Lake Anna.

Entrainment AOI is an important factor in determining the potential impacts of entrainment on phytoplankton and zooplankton. As described in Section 3.6.3.1, the entrainment AOI is the area within which plankton may be drawn into the intake rather than transported away in the ambient flow. For an organism to become entrained, it must enter the entrainment AOI of the cooling water intake system. In connection with Dominion's 40 CFR 122.21(r) submittal to VDEQ, HDR (2021-TN8268) calculated the entrainment AOI to consist of a surface area of 872,500 ft^2 (20 ac; 8 ha) over which organisms may experience the draw of the North Anna intake current. This represents an extremely small portion of Lake Anna (less than 0.1 percent of the lake's total surface area). Therefore, most phytoplankton and zooplankton in Lake Anna are not at risk of entrainment due to the large size of the lake and the relatively small area influenced by North Anna's intake structure. Only those individuals in the entrainment AOI, specifically, would be at risk of entrainment, and although organisms within the AOI have a high probability of being withdrawn by the intake, not all organisms within the AOI will be entrained. The AOI would remain the same during the proposed SLR term.

Finfish monitoring can also provide insight into the health of Lake Anna's phytoplankton and zooplankton communities. As described in Section 3.7.1.1, Dominion performs quarterly gill net and electrofishing sampling of Lake Anna to monitor Lake Anna's aquatic community. All sampling is performed in accordance with Dominion's 2014 study plan (VEPCO 2021-TN8268), which VDEQ and VDGIF have reviewed and approved to ensure that the plan addresses the relevant VPDES permit and CWA Section 316(a) requirements. VDGIF also performs periodic sampling to support its management of the reservoir's fisheries and to inform future stocking. Results of these studies indicate that Lake Anna's fish populations are healthy, and monitoring trends indicate no consistent upward or downward trends in finfish populations over several decades of monitoring. Although these studies do not directly gather information on phytoplankton and zooplankton, it is reasonable to assume that entrainment is not affecting these communities to a degree that causes trophic cascade or monitoring would reveal downward trends of other shifts in the abundance and composition of finfish species that are primary consumers in the trophic structure (see Figure 3-6).

SLR would continue current operating conditions and environmental stressors rather than introduce wholly new impacts. Therefore, the impacts of current operations and SLR on phytoplankton and zooplankton would be similar. For these reasons, the effects of entrainment of phytoplankton and zooplankton would be minor and would neither destabilize nor noticeably alter any important attribute of these populations during the SLR term. The NRC staff concludes that the impacts of entrainment of phytoplankton and zooplankton during the North Anna SLR term would be SMALL.

3.7.3.3 Thermal Impacts on Aquatic Organisms (Plants with Once-Through Cooling Systems or Cooling Ponds)

This section evaluates the thermal impacts of North Anna operations during the proposed SLR term on aquatic organisms. In 2002, the NRC staff evaluated the thermal impacts of the initial North Anna license renewal on aquatic organisms under the issue "heat shock." The NRC staff determined that the impacts of continued operation of North Anna would be SMALL during the initial license renewal term (i.e., 2018–2038 for Unit 1 and 2020–2040 for Unit 2) (NRC 2002-TN665). In 2013, the NRC issued Revision 1 of the LR GEIS (NUREG-1437) (NRC 2013-TN2654). In the revised LR GEIS, the staff renamed the issue of "heat shock" to "thermal impacts on aquatic organisms." The renaming did not affect the scope of the issue for license renewal. This section of this EIS evaluates thermal impacts as they apply to continued operation of North Anna during the proposed subsequent license renewal term (i.e., 2038–2058 for Unit 1, and 2040–2060 for Unit 2).

The primary form of thermal impact of concern at North Anna is heat shock. Heat shock occurs when water temperature meets or exceeds the thermal tolerance of a species for some duration of exposure (NRC 2013-TN2654). In most situations, fish are capable of moving out of an area that exceeds their thermal tolerance limits, although some aquatic species lack such mobility. Heat shock is typically observable only for fish, particularly those that float when dead. In addition to heat shock, thermal plumes resulting from thermal effluent can create barriers to fish passage, which is of particular concern for migratory species. Thermal plumes also can reduce the available aquatic habitat or alter habitat characteristics in a manner that results in cascading effects on the local aquatic community.

North Anna Effluent Discharge

North Anna discharges heated effluent to the WHTF through a single 27-ft (8-m)-deep, 100-ft (30-m)-wide discharge canal. The canal conveys cooling water flow a distance of about 3,600 ft (1,100 m) to the head of the WHTF at a velocity of 2 fps (0.6 m/s). The North Anna VPDES permit limits waste heat rejected to the WHTF from North Anna to 13.54×10^9 BTU)/hour (VEPCO 2020-TN8383). Once within the WHTF, water flows through interconnecting canals and a series of three lagoons. Water residence time in the WHTF is approximately 14 days, depending on the condenser flow rate.

The easternmost dike separating the WHTF lagoons contains the circulating-water outlet, which is a skimmer wall discharge structure with a submerged jet. Effluent re-enters Lake Anna from this jet, designated as Outfall 001 in the VPDES permit, at about 8 fps (2.4 m/s). Although submerged, the slope of the reservoir bottom immediately adjacent to the skimmer wall structure directs the effluent to the surface. The warmer, less dense heated effluent tends to rise to the surface of the reservoir where the remaining waste heat dissipates into the atmosphere.

Typically, no thermal plume is evident in spring or summer, even during near-maximum operating temperatures (VEPCO 2020-TN8099; VEPCO 1986-TN8397). In cooler months, upper lake, mid-lake, and lower lake layers exhibit noticeable temperature differences, but differential cooling and warming of surface waters in the shallow upper lake and the deeper lower lake made it difficult to identify or precisely define a thermal plume (VEPCO 2020-TN8099). The VPDES permit does not require Dominion to report discharge temperatures from the WHTF to Lake Anna (VEPCO 2020-TN8383). However, the permit requires Dominion to monitor water temperatures at locations throughout the WHTF and reservoir (VEPCO 2020-TN8099).

Although several creeks are hydrologically connected to the WHTF, including Elk, Millpond, and Coleman Creeks, these waterbodies do not experience elevated temperatures in connection with North Anna’s thermal effluent due to the direction of discharge flow.

Clean Water Act Section 316(a) Requirements for Point Source Discharges

Section 316(a) of the CWA addresses the adverse environmental impacts associated with thermal discharges into waters of the United States. This section of the act grants the EPA the authority to impose alternative, less-stringent, facility-specific effluent limits (called “variances”) on the thermal component of point source discharges. To be eligible, facilities must demonstrate, to the satisfaction of the NPDES permitting authority, that facility-specific effluent limitations will assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the receiving body of water. CWA Section 316(a) variances are valid for the term of the NPDES permit (i.e., 5 years). Facilities must reapply for variances with each NPDES permit renewal application. The EPA issued regulations under CWA Section 316(a) at 40 CFR 125, Subpart H.

Analysis Approach

When available, the NRC staff relies on the expertise and authority of the NPDES permitting authority with respect to thermal impacts on aquatic organisms. Therefore, if the NPDES permitting authority has made a determination under CWA Section 316(a) that thermal effluent limits are sufficiently stringent to assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the receiving body of water, and that facility has implemented any associated requirements, then the NRC staff assumes that adverse impacts on the aquatic environment will be minimized. In such cases, the NRC staff concludes that thermal impacts on aquatic organisms would be SMALL for the proposed license renewal term.

In cases where the NPDES permitting authority has not granted a CWA Section 316(a) variance, the NRC staff analyzes the potential impacts of thermal discharges using a weight of evidence approach. In this approach, the staff considers multiple lines of evidence to assess the presence or absence of ecological impairment (i.e., noticeable or detectable impact) on the aquatic environment. For instance, as its lines of evidence, the staff might consider characteristics of the cooling water discharge system design, the results of thermal studies performed at the facility, and trends in fish and shellfish population abundance indices. The staff then considers these lines of evidence together to predict the level of impact (SMALL, MODERATE, or LARGE) that the aquatic environment is likely to experience over the course of the proposed LR term.

Baseline Condition of the Resource

For the purposes of its thermal analysis, the NRC staff assumes that the baseline condition of the resource is the Lake Anna aquatic community as it occurs today. The current community is a combination of species that were present during initial impoundment and those that have been stocked for recreational purposes. All fish and benthic invertebrate populations are self-sustaining with the exception of striped bass, which VDGIF continues to stock annually. While species richness, evenness, and diversity within the community may change or shift between now and when the proposed SLR period would begin, the NRC staff finds the aquatic community as it occurs today to be a reasonable surrogate in the absence of fishery- and species-specific projections.

CWA Section 316(a) Thermal Variance

In April 1983, VEPCO notified the Virginia State Water Control Board that it intended to request alternative effluent limitations under CWA Section 316(a). VEPCO sought the variance because water temperatures in Lake Anna in the vicinity of Outfall 001 and in the shallow reaches near all of its tributaries occasionally exceed the maximum regulatory criteria of 32°C (89.6°F), thereby subjecting VEPCO to possible enforcement action under the CWA without an approved CWA Section 316(a) variance. In 1984 and 1985, VEPCO conducted a CWA Section 316(a) demonstration that concluded that alternative temperature effluent limitations are justifiable based on the following factors (VEPCO 1986-TN8397):

- A balanced indigenous community has been maintained.
- The community has not sustained prior appreciable harm.

- A shift toward nuisance species in the receiving water has not occurred and is not likely to occur.
- A zone of passage will not be impaired to the extent that it will not provide for normal movement of populations of dominant species of fish, and economically important species of fish, shellfish, and wildlife.
- There will be no adverse impact on threatened or endangered species.
- There will be no destruction of rare or unique habitat.
- The use of biocides, such as chlorine, has not resulted in appreciable harm to the community.

Section 4.1.3 of the NRC's 2002 final SEIS (NRC 2002-TN665) and Section E4.6.2.4 of Dominion's ER (VEPCO 2020-TN8099) describe this study and its results in detail.

The Virginia State Water Control Board reviewed the demonstration study report and approved the variance in September 1986. As such, the Board found that effluent limitations more stringent than the thermal limitations included in the NPDES permit were not necessary to assure the propagation of a balanced, indigenous population of shellfish, fish, and wildlife in Lake Anna and the North Anna River downstream of the lake (VEPCO 2016-TN8462).

Since the original CWA Section 316(a) demonstration study, Dominion has monitored temperatures using continuous recorders at seven upper lake monitoring stations, three WHTF stations, and one North Anna River station (see Attachment 12 of the VPDES Permit Fact Sheet (VEPCO 2016-TN8462) for temperature recorder locations). On the basis of the original study and this continuing monitoring, Dominion has requested, and VDEQ has granted, continuance of the CWA Section 316(a) variance in successive VPDES permits. Most recently, in 2014, VDEQ evaluated temperature data from Dominion's 2008–2011 post-316(a) monitoring annual reports, consulted with VDGIF, and concluded that its best professional judgment is that the CWA Section 316(a) variance continue with the 2014 renewed VPDES permit (VEPCO 2020-TN8383). VDEQ maintained the post-316(a) demonstration monitoring requirements in the 2014 permit to ensure continued verification of the original CWA Section 316(a) study results and justification for the variance. Section 25 of the VPDES Permit Fact Sheet (VEPCO 2016-TN8462) describes the monitoring requirements in detail.

In its 2018 VDPES permit renewal application, Dominion again requested continuance of the CWA Section 316(a) variance on the basis of the following:

- Facility operations have not significantly increased heat input.
- The station's thermal loading to the lake from North Anna is not expected to increase.
- The annual biological reports indicate that Lake Anna and the lower North Anna River continue to support a well-balanced ecological community.

As part of its VPDES permit renewal application review, VDEQ will consider Dominion's request for continuance of the variance. VDEQ may determine that the original CWA Section 316(a) demonstration, paired with Dominion's continued temperature monitoring, is sufficient to assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in Lake Anna and the North Anna River downstream of the lake. Alternately, VDEQ may require additional mitigation or monitoring in the renewed VPDES permit.

Thermal Impacts Conclusion

Because VDEQ has granted Dominion multiple, sequential variances under CWA Section 316(a), the NRC staff finds that the adverse impacts on the aquatic environment associated thermal effluent are minimized. Because characteristics of the thermal effluent would remain the same under the proposed action, the NRC staff anticipates similar effects during the proposed SLR period. Further, VDEQ will continue to review the CWA Section 316(a) variance with each successive VPDES permit renewal and may require additional mitigation or monitoring in a future renewed VPDES permit if it deems such actions to be appropriate to assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in Lake Anna and the North Anna River downstream of the lake. The NRC staff assumes that any additional requirements that VDEQ imposes would further reduce the impacts of the North Anna thermal effluent over the course of the proposed SLR term. For these reasons, the NRC staff finds that thermal impacts during the proposed SLR period would neither destabilize nor noticeably alter any important attribute of the aquatic environment and would, therefore, result in SMALL impacts on aquatic organisms.

3.7.3.4 Infrequently Reported Thermal Impacts (All Plants)

This issue concerns the infrequently reported effects of thermal effluents. These effects include cold shock, thermal migration barriers, accelerated maturation of freshwater aquatic insects, and proliferated growth of aquatic nuisance species.

Cold shock occurs when an organism has been acclimated to a specific water temperature or range of temperatures and is subsequently exposed to a rapid decrease in temperature. This can result in a cascade of physiological and behavioral responses and, in some cases, death (Donaldson et al. 2008-TN7515). Rapid temperature decreases may occur from either natural sources (e.g., thermocline temperature variation and storm events) or anthropogenic sources (e.g., thermal effluent discharges). The magnitude, duration, and frequency of the temperature change, as well as the initial acclimation temperatures of individuals, can influence the extent of the consequences of cold shock on fish and other aquatic organisms (Donaldson et al. 2008-TN7515). At nuclear power plants, cold shock could occur during refueling outages, reductions in power generation level, or other situations that would quickly reduce the amount of cooling capacity required at the plant. Cold shock is most likely to be observable in the winter. The 1996 LR GEIS reports that cold shock events have only rarely occurred at nuclear power plants. Fish mortalities usually involved only a few fish and did not result in population-level effects. Gradual depowering or shutdown of plant operations, especially in winter months, can mitigate the effects of cold shock.

Thermal effluents have the potential to create migration barriers if the thermal plume covers an extensive cross-sectional area of a river and temperatures within the plume exceed a species' physiological tolerance limit. This impact has been examined at several nuclear power plants, but it has not been determined to result in observable effects (NRC 1996-TN288, NRC 2013-TN2654).

The 1996 LR GEIS and 2013 LR GEIS considered that the heated effluents of nuclear power plants could accelerate the maturation of aquatic insects in freshwater systems and cause premature emergence. The maturation and emergence of aquatic insects are often closely associated with water temperature regimes. If insects develop or emerge early in the season, they may be unable to feed or reproduce or they may die because the local climate is not warm enough to support them.

The 1996 LR GEIS and 2013 LR GEIS also considered that heated effluents could proliferate the growth of aquatic nuisance organisms. Aquatic nuisance species are organisms that disrupt the ecological stability of infested inland (e.g., rivers and lakes), estuarine, or marine waters (EPA 2022-TN7519). Both of the LR GEISs discuss zebra mussels (*Dreissena polymorpha*) and Asiatic clam (*Corbicula fluminea*), two bivalves that are of particular concern in many freshwater systems because they can cause significant biofouling of industrial intake pipes at power and water facilities. These species are also of ecological concern because they outcompete and lead to the decline of native freshwater mussels. Nuclear power plants that withdraw water from water bodies in which these species are known to occur often periodically chlorinate intake pipes or have other procedures in place to mitigate the spread of these bivalves. There is no evidence, however, that thermal effluent leads to these species' proliferation.

Langford (1983-TN7676) reports several of instances in which wood-boring crustaceans and mollusks, notably "shipworms," have caused concern in British waters. Although increased abundance of shipworms in the area influenced by heated power plant effluents caused substantial damage to wooden structures, replacement of old wood with concrete or metal structures eliminated the problem. Langford concluded that increased temperatures could enhance the activity and reproduction of wood-boring organisms in enclosed or limited areas but that elevated temperature patterns were not sufficiently stable to cause widespread effects.

The 1996 LR GEIS (NRC 1996-TN288) and the 2013 LR GEIS (NRC 2013-TN2654) concluded that these infrequently reported thermal impacts would be SMALL during the initial license renewal term. The 1996 LR GEIS evaluated these concerns as five issues; the 2013 GEIS consolidated them into one issue. In the North Anna LR final SEIS (NRC 2002-TN665), the NRC staff found no new and significant information concerning these issues, and the NRC staff adopted the 1996 LR GEIS's conclusion of SMALL for North Anna initial license renewal. Below, the NRC staff analyzes this issue site-specifically for the SLR term, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN8272).

With respect to cold shock, no such events have been reported at North Anna. Because SLR would continue current operating conditions, cold shock is not expected to be of concern during the SLR period.

With respect to thermal migration barriers, this issue is not relevant to North Anna because North Anna's thermal effluent discharges to a lake.

The potential concerns of accelerated maturation of freshwater aquatic insects and proliferated growth of aquatic nuisance species have not been documented at North Anna. Zebra mussels and Asiatic clams do not occur in Lake Anna and have not been reported from the North Anna River. Shipworms are not of concern because North Anna does not discharge to coastal waters.

SLR would continue current operating conditions and environmental stressors rather than introduce wholly new impacts. Therefore, the impacts of current operations and SLR on would be similar. For these reasons, infrequently reported thermal impacts would be minor and would neither destabilize nor noticeably alter any important attribute of the aquatic environment during the SLR term. The NRC staff concludes that infrequently reported thermal impacts on aquatic resources during the North Anna SLR term would be SMALL.

3.7.3.5 Effects of Cooling Water Discharge on Dissolved Oxygen, Gas Supersaturation, and Eutrophication

This issue concerns the effects of thermal effluents on dissolved oxygen, gas supersaturation, and eutrophication. Because nuclear power plant effluents are heated, discharged water can change certain biological conditions in the receiving water body in a manner that affects the characteristics of that habitat and the potentially suitability of that habitat for local fish, shellfish, and other aquatic organisms.

Aerobic organisms, such as fish, require oxygen, and the concentration of dissolved oxygen in a water body is one of the most important ecological water quality parameters. Dissolved oxygen also influences several inorganic chemical reactions. In general, dissolved oxygen concentrations of less than 3 parts per million in warmwater habitats or less than 5 parts per million in cold-water habitats can adversely affect fish (Morrow and Fischenich 2000-TN7351). Oxygen dissolves into water via diffusion, aeration, and as a product of photosynthesis. The amount of oxygen water can absorb depends on temperature; the amount of oxygen that can dissolve in a volume of water (i.e., the saturation point) is inversely proportional to the temperature of the water. Thus, when other chemical and physical conditions are equal, the warmer the water is, the less dissolved oxygen it can hold. Increased water temperatures also affect the amount of oxygen that aquatic organisms need by increasing metabolic rates and chemical reaction rates. The rates of many chemical reactions in water approximately doubles for every 18°F (10°C) increase in temperature.

The thermal effluent discharges of nuclear power plants have the potential to stress aquatic organisms by simultaneously increasing these organisms' need for oxygen and decreasing oxygen availability. Aquatic organisms are more likely to experience adverse effects from thermal effluents in ecosystems where dissolved oxygen levels are already approaching suboptimal levels from other factors in the environment. This is most likely to occur in ecosystems where increased levels of detritus and nutrients (e.g., eutrophication), low flow, and high ambient temperatures already exist. These conditions can occur from drought conditions or in hot weather, especially in lakes, reservoirs, or other dammed freshwater.

Although the thermal effluents of nuclear power plants may contribute to reduced dissolved oxygen in the immediate vicinity of the discharge point, as the effluent disperses, diffusion and aeration from turbulent movement introduces additional oxygen into the water. As the water cools, the saturation point increases, and the water can absorb additional oxygen as it is released by aquatic plants and algae through photosynthesis, which is a continuously ongoing process during daylight hours. Therefore, lower dissolved oxygen is generally only a concern within the thermal mixing zone, which is typically a small area of the receiving water body. Many states address thermal mixing zones in State water quality criteria to ensure that mixing zones provide a continuous zone of passage for aquatic organisms. Additionally, the EPA, or authorized States and Tribes, often impose conditions specifically addressing dissolved oxygen through NPDES permits to ensure that receiving water bodies maintain adequate levels of oxygen to support aquatic life. These conditions are established pursuant to CWA Section 316(a), which requires that regulated facilities operate under effluents limitations that assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the receiving water body.

Rapid heating of cooling water can also affect the solubility and saturation point of other dissolved gases, including nitrogen. As water passes through the condenser cooling system, it can become supersaturated with gases. Once the supersaturated water is discharged in the receiving water body, dissolved gas levels equilibrate as the effluent cools and mixes with ambient water. This process is of concern if aquatic organisms remain in the supersaturated effluent for a long enough period to become equilibrated to the increased pressure associated with the effluent. If these organisms then move into water of lower pressure too quickly when, for example, swimming out of the thermal effluent or diving to depths, the dissolved gases within the affected tissues may come out of solution and form embolisms (bubbles). The resulting condition is known as gas bubble disease. In fish, it is most noticeable in the eyes and fins. Affected tissues can swell or hemorrhage and result in behavioral abnormalities, increased susceptibility to predation, or death. Mortality in fish generally occurs at gas supersaturation levels above 110 or 115 percent (EPA 1986-TN7726). Aquatic insects and crustaceans appear to be more tolerant of supersaturated water (Nebeker et al. 1981-TN7725).

The ability to detect and avoid supersaturated waters varies among species. A fish can avoid supersaturated waters by either not entering the affected area or by diving to avoid the onset of supersaturated conditions near the surface. Some species, however, may not avoid supersaturated waters until symptoms of gas bubble disease occur; at that point, some fish may already be lethally exposed. Other species may be attracted to supersaturated waters because it is often warmer (Gray et al. 1983-TN7727).

An early concern about nuclear power plant discharges was that thermal effluents would cause or speed eutrophication by stimulating biological productivity in receiving water bodies (NRC 1996-TN288). Eutrophication is the gradual increase in the concentration of phosphorus, nitrogen, and other nutrients in a slow-flowing or stagnant aquatic ecosystem, such as a lake. These nutrients enter the ecosystem primarily through runoff from agricultural land and impervious surfaces. The increase in nutrient content allows alga to proliferate on the water’s surface, which reduces light penetration and oxygen absorption necessary for underwater life. The 1996 LR GEIS reports that several nuclear power plants conducted long-term monitoring to investigate this potential effect. No evidence of eutrophication was detected.

The 1996 LR GEIS and 2013 LR GEIS report cases of fish mortality from gas bubble disease at hydroelectric dams and coal-fired power plants. Typically, gas bubble disease is of concern at facilities where the configuration of the discharge allows organisms to reside in the supersaturated effluent for extended periods of time (e.g., discharge canals that fish can freely enter). However, fish mortality from gas bubble disease has been observed in only one instance in the mid-1970s at a nuclear power plant that is no longer operating.

The 1996 LR GEIS (NRC 1996-TN288) and the 2013 LR GEIS (NRC 2013-TN2654) concluded that the effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication would be SMALL during the initial license renewal term. The 1996 LR GEIS evaluated these concerns as three issues; the 2013 GEIS consolidated them into one issue. In the North Anna LR final SEIS (NRC 2002-TN665), the NRC staff found no new and significant information concerning these issues, and the NRC staff adopted the 1996 LR GEIS’s conclusion of SMALL for North Anna initial license renewal. Below, the NRC staff analyzes this issue site-specifically for the SLR term, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN8272).

With respect to dissolved oxygen, North Anna’s VPDES permit requires that the biochemical oxygen demand in effluent discharges be at least 30 mg/L or 3.4 kg/day (monthly average) and 45 mg/L or 5.1 kg/day (weekly average) (VEPCO 2020-TN8383). The NRC staff reviewed records related to this permit, and Dominion has reported no violations of these levels in the past 5 years (VEPCO 2022-TN8270). Because SLR would continue current operating conditions and because the site's VPDES permit would continue require minimum levels of and monitoring for dissolved oxygen, reduced dissolved oxygen resulting from North Anna's thermal effluent is not expected to be of concern during the SLR period.

With respect to gas supersaturation, Dominion has not reported any instances of fish kills at North Anna or any other information indicating that fish in Lake Anna may have experienced symptoms of gas bubble disease. Because SLR would continue current operating conditions, gas supersaturation resulting from North Anna's thermal effluent is not expected to be of concern during the SLR period.

With respect to eutrophication, Section 3.10.3 describes seasonal cyanobacteria blooms that have been reported for several different areas of Lake Anna. The appearance of harmful algal blooms in Lake Anna is a relatively new issue that first occurred in the summer of 2018. Blooms also occurred in 2019 and 2020. In each instance, the blooms appeared between July and September when elevated temperatures, reduced water clarity, and elevated phosphorus and nitrogen concentrations combined to create favorable growth conditions. Within the WHTF, Beaver Creek, Elk Creek, Millpond, and Moody Creek were affected in 2018 and Beaver Creek was affected in 2019. Table 3-31 lists the affected branches of Lake Anna.

The widespread occurrence of these blooms indicates that there are contributing factors beyond North Anna operations. North Anna thermal discharges may contribute to favorable bloom conditions within and near the WHTF, but other conditions must also be present for blooms to occur. These include lower water clarity and higher nutrient concentrations, which are factors that would not be associated with North Anna operations. North Anna operations are unlikely to contribute to blooms that occur beyond the reach of the North Anna thermal plume, such as the various arms of Lake Anna identified in Table 3-31, many of which are several miles from North Anna.

The Virginia Department of Health (VDH) and Dominion have developed monitoring programs to sample suspected blooms. VDH performs monitoring in Lake Anna, and Dominion performs sampling in the WHTF. Neither VDH nor Dominion have identified any harmful algal blooms in Lake Anna since 2020 (VEPCO 2023-TN8534; VHD 2022-TN8468). During the proposed license renewal term, Dominion would continue monitoring cyanobacteria, issuing advisories, and coordinating with VDH on harmful algal blooms (VEPCO 2021-TN8524). Because monitoring is in place, combined with the fact that North Anna's thermal effluent did not cause the observed blooms in 2018, 2019, and 2020, eutrophication is not expected to be of concern during the SLR period.

Current operating conditions and environmental stressors would continue under the SLR rather than introducing wholly new impacts. Therefore, the impacts of current operations and SLR on would be similar. For these reasons, dissolved oxygen, gas supersaturation, and eutrophication would be minor and would neither destabilize nor noticeably alter any important attribute of the aquatic environment during the SLR term. The NRC staff concludes that the effects of dissolved oxygen, gas supersaturation, and eutrophication on aquatic resources during the North Anna SLR term would be SMALL.

3.7.3.6 Effects of Non-radiological Contaminants on Aquatic Organisms

This issue concerns the potential effects of nonradiological contaminants on aquatic organisms that could occur from nuclear power plant operations. It initially became a concern because some nuclear power plants used heavy metals in condenser tubing that could leach from the tubing and expose aquatic organisms to these contaminants. Because aquatic organisms can bioaccumulate heavy metals, even when exposed at low levels, this can be toxic to fish and other animals that consume contaminated organisms. Section 3.9.2 of the 2013 LR GEIS (NRC 2013-TN2654) describes instances in which copper contamination was an issue at operating nuclear power plants. Heavy metals have not been found to be of concern other than these few instances. In all cases, the nuclear power plants eliminated leaching by replacing the affected piping, and these changes were implemented during the initial operating license terms. The NRC staff has not identified this issue to be of concern during any license renewal reviews to date.

The 1996 LR GEIS (NRC 1996-TN288) and the 2013 LR GEIS (NRC 2013-TN2654) concluded that the effects of nonradiological contaminants on aquatic organisms would be SMALL during the initial license renewal term. In the North Anna LR final SEIS (NRC 2002-TN665), the NRC staff found no new and significant information concerning these issues, and the NRC staff adopted the 1996 LR GEIS's conclusion of SMALL for North Anna initial license renewal. Below, the NRC staff analyzes this issue site-specifically for the SLR term, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN8272).

North Anna does not use heavy metals in its condenser tubing or have copper piping that would cause contamination in effluents discharged to Lake Anna. Dominion circulates sponge rubber balls through the condenser tubes to prevent the accumulation of deposits, such as biofouling organisms and debris and nutrient buildup. The rubber balls are collected and reused; no chemical biocides are added to the circulating water system (VEPCO 2022-TN8270).

For certain plant equipment and systems, Dominion uses VDEQ-approved chemical additives to control pH, scale, corrosion, and biofouling. Section 3.5.3 of this EIS addresses the discharge of metals in cooling system effluent. As explained in that section, North Anna's VPDES permit establishes allowable levels of metals, including zinc, copper, iron, mercury, lead, nickel, and silver, in wastewater discharges from Outfall 001, which is a subsurface discharge to the discharge canal that then discharges to Lake Anna. The permit also limits zinc and chromium limits at Outfall 105, the bearing cooling tower blowdown. Additionally, no detectable concentrations of the 126 priority pollutants may be present in chemical additives to the bearing cooling tower in the final effluent. The permit requires Dominion to sample and report levels of metals, among other chemicals and water quality criteria, to the VDEQ to demonstrate permit compliance. The NRC staff reviewed Dominion's VPDES monitoring reports for the past 5 years, and Dominion has reported no violations related to discharge of metals in wastewater or stormwater discharges (VEPCO 2023-TN8534_BA_RAI). During the SLR term, metals in cooling system effluent would continue to be controlled and monitored through the VPDES permit, which would ensure that potential impacts of these contaminants on the aquatic environment would be minimized.

SLR would continue current operating conditions and environmental stressors rather than introduce wholly new impacts. Therefore, the impacts of current operations and SLR on would be similar. For these reasons, the effects of nonradiological contaminants on aquatic organisms would be minor and would neither destabilize nor noticeably alter any important attribute of the aquatic environment during the SLR term. The NRC staff concludes that the effects of nonradiological contaminants on aquatic organisms during the North Anna SLR term would be SMALL.

3.7.3.7 *Exposure of Aquatic Organisms to Radionuclides*

This issue concerns the potential impacts on aquatic organisms from exposure to radionuclides from routine radiological effluent releases. During normal operations, nuclear power plants can release gaseous emissions that deposit small amounts of radioactive particulates in the surrounding environment. Gaseous emissions typically include krypton, xenon, and argon (which may or may not be radioactive), tritium, isotopes of iodine, and cesium. Emissions may also include strontium, cobalt, and chromium. Radionuclides also may be released into water as liquid effluent. Aquatic plants can absorb radionuclides that enter shallow groundwater or surface waters through their roots. Aquatic animals can be exposed externally to ionizing radiation from radionuclides in water, sediment, and other biota and can be exposed internally through ingested food, water, and sediment and absorption through the integument and respiratory organs.

The 1996 LR GEIS (NRC 1996-TN288) did not address this issue. In 2007, the International Commission on Radiation Protection (ICRP) issued revised recommendations for a system of protection to control exposure from radiation sources (ICRP 2007-TN422). The recommendations included a section about the protection of the environment in which the ICRP found that a clearer framework for assessing nonhuman organisms was warranted. The ICRP indicated that it would develop a set of reference animals and plants as the basis for relating exposure to dose, and dose to radiation effects, for different types of organisms. This information would then provide a basis from which agencies and responsible organizations could make policy and management decisions. Subsequently, the ICRP developed and published a set of 12 reference animals and plants ICRP 2008-TN7530, ICRP 2009-TN7531). They include a large and small terrestrial mammal, an aquatic bird, and a large and small terrestrial plant, among others. The ICRP also issues publications and information related to radiological effects and radiosensitivity in non-human biota (Adam-Guillermin et al. 2018-TN7972).

In 2009, following the NRC staff's review of the ICRP's 2007 recommendations, the Commission found that there is no evidence that NRC's current set of radiation protection controls is not protective of the environment (NRC 2009-TN6651). For this reason, the Commission determined that the NRC staff should not develop separate radiation protection regulations for plant and animal species (NRC 2009-TN6651).[4] The Commission charged the NRC staff with continuing to monitoring international developments on this issue and to keep the Commission informed of any such developments. Nonetheless, the NRC staff addressed radiological exposure of nonhuman organisms in the 2013 LR GEIS (NRC 2013-TN2654) due to public concern about these impacts at some nuclear power plants.

In the 2013 LR GEIS, the NRC staff adopted DOE's standard on a graded approach for evaluating radiation doses to terrestrial and aquatic biota (DOE 2019-TN6817). The DOE standard provides methods, models and guidance that can be used to characterize radiation doses to terrestrial and aquatic biota exposed to radioactive material (DOE 2019-TN6817). The following DOE guidance dose rates are the levels below which no adverse effects to resident populations are expected:

- riparian animal (0.1 radiation-absorbed dose per day [rad/d]; 0.001 gray per day [Gy/d])

[4] Also see SECY-04-0223 (NRC 2004-TN6431), SECY-06-0168 (NRC 2006-TN6430), SECY-08-0197 (NRC 2008-TN6432), SECY-04-0055 (NRC 2004-TN7100), and related Staff Requirements Memorandums SRM-SECY-04-0223 (NRC 2005-TN6649), SRM-SECY-06-0168 (NRC 2005-TN6650), SRM-SECY-08-019 (NRC 2009-TN6651), and SRM-SECY-04-0055 (NRC 2004-TN7101).

- terrestrial animal (0.1 rad/d) (0.001 Gy/d)
- terrestrial plant (1 rad/d) (0.01 Gy/d)
- aquatic animal (1 rad/d) (0.01 Gy/d)

Previously, in 1992, the International Atomic Energy Agency (IAEA 1992-TN712) also concluded that chronic dose rates of 0.1 rad/d (0.001 Gy/d) or less do not appear to cause observable changes in terrestrial animal populations. The United Nations Scientific Committee on the Effects of Atomic Radiation concluded in 1996 and re-affirmed in 2008 that chronic dose rates of less than 0.1 mGy/hr (0.24 rad/d or 0.0024 Gy/d) to the most highly exposed individuals would be unlikely to have significant effects on most terrestrial communities (UNSCEAR 2010-TN7974).

In the 2013 LR GEIS, the NRC staff estimated the total radiological dose that the four non-human receptors listed above (i.e., riparian animal, terrestrial animal, terrestrial plant, and aquatic animal) would be expected to receive during normal nuclear power plant operations based on plant-specific radionuclide concentrations in water, sediment, and soils at 15 operating nuclear power plants using Argonne National Laboratory’s RESRAD-BIOTA dose evaluation model. The NRC found that total calculated dose rates for aquatic animals at all 15 plants were all less than 0.2 rad/d (0.002 Gy/d), which is less than the guideline value of 1 rad/d (0.01 Gy/d). As a result, the NRC staff anticipated in the 2013 LR GEIS that normal operations of these facilities would not result in negative effects on terrestrial biota. The 2013 LR GEIS concluded that the impact of radionuclides on terrestrial biota from past operations would be SMALL for all nuclear plants and would not be expected to change appreciably during the initial license renewal period.

The NRC staff did not specifically address the exposure of terrestrial organisms to radionuclides during the initial license renewal period in the North Anna LR final SEIS (NRC 2002-TN665). As indicated previously in this section, this issue was not addressed in the 1996 LR GEIS, upon which the North Anna LR final SEIS relied. However, as explained above, the 2013 GEIS later addressed this issue generically for initial license renewal of all nuclear power plants and concluded that impacts would be SMALL. Below, the NRC staff analyzes this issue site specifically for the SLR term, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN8272).

The NRC requires nuclear power plants to maintain a REMP through its regulations at 10 CFR Part 50, Appendix I, 10 CFR Part 20-TN283, and 10 CFR Part 72, and through plant-specific technical specifications. These collectively require that licensees establish and implement a REMP to obtain data on measurable levels of radiation and radioactive material. The NRC provides guidance to licensees on acceptance methods for establishing and conducting REMPs in Regulatory Guide 4.1 (NRC 2009-TN3802).

Dominion established its REMP prior to when North Anna began commercial operations to gather data on background radiation and radioactivity normally present in the area. Dominion has continued to sample air, water, sediment, soil, fish, milk, and food and vegetation products annually for radionuclides. Teledyne Brown Engineering Environmental Services personnel collect and analyze REMP samples on behalf of Dominion, samples are independently verified through Dominion’s participate in an Interlaboratory Comparison Program, and final results are reported to the NRC. REMP sampling includes indicator and control locations within a 25 mi (40 km) radius of the plant. The indicator locations are designed to detect any increases or buildup of radioactivity that might occur due to North Anna operation. Control locations are farther away to monitor naturally occurring radioactivity. Researchers compare monitoring results at indicator and control locations to assess any radiological impacts North Anna operations might be having on the surrounding environment.

Dominion samples water and aquatic exposure pathways, including precipitation, surface water, river and well water, silt and shoreline sediment, and fish as part of its REMP. Since North Anna began operating, REMP results have not indicated any significant radiological impacts on the surrounding environment attributable to North Anna operations. As part of its environmental review, the NRC staff reviewed the past five years of REMP reports (VEPCO 2022-TN8476, 2021-TN8394, VEPCO 2020-TN8393, 2019-TN8392, VEPCO 2018-TN8391). During this period, no radioactive isotopes related to North Anna operation were detected in fish samples from either Lake Anna or Lake Orange, the control location, during this period. Silt and shoreline soil samples indicated the presence of potassium-40 and thorium and uranium decay daughters at levels consistent with natural background radiation.

In summary, NRC regulations require nuclear power plants to monitor radiation in the environment and to report the results of such monitoring to the NRC through a REMP. REMP monitoring ensures that levels of radiation are below regulatory limits and that any changes in radionuclide concentrations are detected and addressed. To date, Dominion has not detected levels of radioactivity attributable to North Anna operations that would result in measurable radiological impacts on terrestrial organisms. SLR would continue current operating conditions and environmental stressors rather than introduce wholly new impacts. For these reasons, radiological impacts would be minor and would neither destabilize nor noticeably alter any important attribute of the terrestrial environment during the SLR term. The NRC staff concludes that exposure of aquatic organisms to radionuclides during the North Anna SLR term would be SMALL.

3.7.3.8 Effects of Dredging on Aquatic Resources

This issue concerns the effects of dredging at nuclear power plants on aquatic resources. Small-particle sediment, such as sand and silt, that enters water bodies through erosion can subsequently deposit and accumulate along shorelines and in shallow water areas. If sediment deposition affects cooling system function or reliability, a nuclear power plant may need to periodically dredge to improve intake flow and keep the area clear of sediment. Nuclear power plants where dredging may be necessary are typically located along fast-flowing waters with sandy or silty bottoms, such as large rivers or the ocean. In some instances, dredging may be performed to maintain barge slips for transport of materials and waste to and from the site. Dredging entails excavating a layer of sediment from the affected areas and transporting that sediment to onshore or offshore areas for disposal. The three main types of dredges are mechanical dredges, hydraulic dredges, and airlift dredges. The selection of dredge type generally is related to the sediment type, the size of the area to be dredged, and the aquatic resources present. At operating nuclear power plants, dredging is performed infrequently, if at all.

The 1996 LR GEIS (NRC 1996-TN288) and the 2013 LR GEIS (NRC 2013-TN2654) concluded that the effects of dredging on aquatic resources would be SMALL during the initial license renewal term. In the North Anna LR final SEIS (NRC 2002-TN665), the NRC staff found no new and significant information concerning this issue, and the NRC staff adopted the 1996 LR GEIS's conclusion of SMALL for North Anna initial license renewal. Below, the NRC staff analyzes this issue site-specifically for the SLR term, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN8272).

Dominion (2020-TN8383) anticipates no dredging as part of SLR. Therefore, there would be no impacts on aquatic resources. If Dominion determined at a future date that dredging was necessary to, for instance, provide adequate shoreline clearance, dredging would require Dominion to obtain permits from USACE under CWA Section 404. Best management practices and conditions associated with these permits would minimize impacts on the ecological environment. The granting of such permits would also require the USACE to conduct its own environmental reviews prior to undertaking dredging.

The NRC staff expects that the effects of dredging on aquatic resources would be minor and would neither destabilize nor noticeably alter any important attribute of the aquatic environment during the SLR term. The NRC assumes that Dominion would continue to implement site environmental procedures and would obtain any necessary permits for dredging activities, if determined necessary. Implementation of such controls would further reduce or mitigate potential effects. The NRC staff concludes that the effects of dredging on aquatic resources during the North Anna SLR term would be SMALL.

3.7.3.9 Effects on Aquatic Resources (Non-Cooling System Impacts)

This issue concerns the effects of nuclear power plant operations on aquatic resources during SLR that are unrelated to operation of the cooling system. Such activities include landscape and grounds maintenance, stormwater management, and ground-disturbing activities that could directly disturb aquatic habitat or cause runoff or sedimentation. These impacts are expected to be like past and ongoing impacts that aquatic resources are already experiencing at the nuclear power plant site.

The 1996 LR GEIS (NRC 1996-TN288) and the 2013 LR GEIS (NRC 2013-TN2654) concluded that non-cooling system impacts on aquatic resources would be SMALL during the initial license renewal term. In the 1996 LR GEIS, the NRC staff evaluated the impacts of refurbishment on aquatic resources. In the 2013 LR GEIS, the NRC staff expanded this issue to include impacts of other site activities, unrelated to cooling system operation, that may affect aquatic resources. In the North Anna LR final SEIS (NRC 2002-TN665), the NRC staff found no new and significant information concerning this issue, and the NRC staff adopted the 1996 LR GEIS’s conclusion of SMALL for North Anna initial license renewal. Below, the NRC staff analyzes this issue site specifically for the SLR term, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN8272).

Within the North Anna site, aquatic features include Lake Anna and the North Anna River. As explained in Section 3.5.4, environmental impacts from landscape maintenance, ground-disturbing activities, and other operational activities would be minimized because Dominion maintains environmental control procedures for any activities that result in the clearing of land, excavation, or other activity that would alter the physical environment or ecology of the site (VEPCO 2020-TN8099). Dominion’s procedures direct personnel to obtain appropriate local, State, or Federal permits (or some combination of the three) before beginning work; implement best practices to protect sensitive ecosystems; and consult the appropriate agencies wherever federally or State-listed species may be affected. North Anna’s Environmental Protection Plan contained in Appendix B of the renewed operating licenses requires Dominion to prepare an environmental evaluation for any construction or operational activities which may significantly affect the environment (NRC 2003-TN8607). If such an evaluation indicates that an activity involves an unreviewed environmental question, the North Anna Environmental Protection Plan requires that Dominion obtain approval from the NRC before performing the activity (NRC 2003-TN8607). The subsequent renewed licenses would contain identical or similar requirements.

With respect to stormwater management, stormwater runoff from impervious surfaces can change the frequency or duration of inundation and soil infiltration within riparian areas and neighboring habitats. Effects of stormwater runoff may include erosion, altered hydrology, sedimentation, and other changes to plant community characteristics. Runoff may contain sediments, contaminants and oils from road or parking surfaces, or herbicides. At North Anna, stormwater collected in industrial areas and drains to one of five external outfalls permitted under the VPDES permit (Outfalls 014, 022, 024, 025, and 027), which are depicted in Figure 3-2. Dominion maintains a Stormwater Pollution Prevention Plan that identifies potential sources of pollutants that could affect stormwater discharges and includes BMPs that Dominion uses to reduce pollutants in stormwater discharges to ensure compliance with applicable conditions of the VPDES permit (VEPCO 2020-TN8099, VEPCO 2020-TN8383). Dominion also has developed a Spill Prevention, Control, and Countermeasures Plan that identifies and describes the procedures, materials, equipment, and facilities that are utilized to minimize the frequency and severity of oil spills (VEPCO 2020-TN8099, VEPCO 2020-TN8383). Collectively, these measures ensure that the effects to aquatic resources from pollutants carried by stormwater would be minimized during the SLR term.

The SLR would continue current operating conditions and environmental stressors rather than introduce wholly new impacts. Therefore, the impacts of current operations and SLR would be similar. For these reasons, non-cooling system impacts on aquatic resources would be minor and would neither destabilize nor noticeably alter any important attribute of the aquatic environment during the SLR term. The NRC staff concludes that non-cooling system impacts on aquatic resources during the North Anna SLR term would be SMALL.

3.7.3.10 Impacts of Transmission Line Right-of-Way (ROW) Management on Aquatic Resources

This issue concerns the effects of transmission line ROW management on aquatic plants and animals. Transmission line management can directly disturb aquatic habitats if ROWs traverse aquatic features and heavy machinery is used in these areas. Heavy equipment can also compact soils, which can affect soil quality and reduce infiltration to shallow groundwater, resulting in runoff and erosion in nearby aquatic habitats. Chemical herbicides applied in ROWs can be transported to nearby aquatic habitats through precipitation and runoff. For small streams, trees may grow sufficiently between cutting cycles to provide shading and support microhabitats. Tree removal to maintain appropriate transmission line clearance could alter the suitability of habitats for fish and other aquatic organisms and locally increase water temperatures.

The 1996 LR GEIS (NRC 1996-TN288) and the 2013 LR GEIS (NRC 2013-TN2654) concluded that the impacts of transmission line ROW management on aquatic resources would be SMALL during the initial license renewal term. In the North Anna LR final SEIS (NRC 2002-TN665), the NRC staff found no new and significant information concerning this issue, and the NRC staff adopted the 1996 LR GEIS's conclusion of SMALL for North Anna initial license renewal. Below, the NRC staff analyzes this issue site-specifically for the SLR term, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN8272).

As explained in Section 3.5.4, which discusses the impacts of transmission line ROW maintenance on terrestrial resources, the transmission lines within the scope of the North Anna SLR review are contained within the industrial use portion of the site. They do not cross any natural areas and vegetation management is not required. Therefore, maintenance of these lines has no discernable effect on ecological resources.

The SLR would continue current operating conditions and environmental stressors rather than introduce wholly new impacts. Therefore, the impacts of current operations and SLR would be similar. For these reasons, the effects of transmission line ROW maintenance on aquatic resources would be minor and would neither destabilize nor noticeably alter any important attribute of plant or animal populations during the SLR term. The NRC staff concludes that the impacts of transmission line ROW maintenance on aquatic resources during the North Anna SLR term would be SMALL.

3.7.3.11 Losses from Predation, Parasitism, and Disease Among Organisms Exposed to Sublethal Stresses

This issue concerns the effects of nuclear power plant operation that can increase aquatic organisms' susceptibility to predation, parasitism, and disease. Such sublethal effects can result from impingement, if an organism is subsequently returned to the source waterbody, as well as from exposure to thermal effluents. This issue does not apply to entrainment. Because entrainable organisms generally consist of fragile life stages, all entrained organisms are assumed to die (79 FR 48300-TN4488) and would, therefore, not survive entrainment to subsequently experience sublethal effects.

The 1996 LR GEIS (NRC 1996-TN288) and the 2013 LR GEIS (NRC 2013-TN2654) concluded that the losses from predation, parasitism, and disease among organisms exposed to sublethal stresses would be SMALL during the initial license renewal term. In the North Anna LR final SEIS (NRC 2002-TN665), the NRC staff found no new and significant information concerning this issue, and the NRC staff adopted the 1996 LR GEIS's conclusion of SMALL for North Anna initial license renewal. Below, the NRC staff analyzes this issue site-specifically for the SLR term, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN8272).

<u>Sublethal Effects of Impingement</u>

The regulations in the EPA's 2014 CWA Section 316(b) establish best technology available standards for impingement mortality. Impingement mortality considers the survival rate of impinged organisms, rather than simply the total number of organisms impinged. Survival studies typically consider latent mortality associated with stunning, disorientation, or injury. Such effects can result from the injury itself or from increased susceptibility to predation, parasitism, or disease that results from the sublethal effects of impingement. As explained in Section 3.6.3.1, the North Anna intake system does not include a fish return system, and Dominion has no plans to alter the design or function of the cooling system under the proposed action. Therefore, all impingement would result in mortality, and the issue of sublethal effects from impingement does not apply to North Anna.

<u>Sublethal Effects of Thermal Effluents</u>

Fish and shellfish that are exposed to the thermal effluent of a nuclear power plant may experience stunning, disorientation, or injury. These sublethal effects can subsequently affect an organism's susceptibility to predation, parasitism, or disease.

With respect to susceptibility to predation, laboratory studies of the secondary mortality of fish following exposure to heat or cold shock demonstrate increased susceptibility of these fish to predation; however, field evidence of such effects is often limited to anecdotal information, such as observations of increased feeding activity of seagulls and predatory fish near effluent outfalls (e.g., Cada et al. 1981-TN7733). For example, Barkley and Perrin (1971-TN7734) and Romberg et al. (1974-TN7891) reported increased concentrations of predators feeding on forage fish attracted to thermal plumes. However, these studies did not quantify whether the observed behaviors resulted in population-level effects on prey species.

With respect to susceptibility to parasitism and disease, Langford (1983-TN7676) found that the tendency for fish to congregate in heated effluent plumes, the increased physiological stress that higher water temperatures exert on fish, and the ability of some diseases and parasites to proliferate at higher temperatures were all factors that could contribute to increased rates of disease or parasitism in exposed fish. Some studies have suggested that crowding of fish within the thermal plume, rather than the thermal plume itself, may be lead to an increased risk of exposure to infectious diseases (Coutant 1987-TN7736).

The 1996 LR GEIS and 2013 LR GEIS reported that neither scientific literature reviews nor consultations with agencies or utilities yielded clear evidence of nuclear power plant operation causing sublethal effects that result in noticeable increases in the susceptibility of exposed organisms to predation, parasitism, or disease. Dominion (2020-TN8383) reports no evidence of such effects, and Dominion’s continued adherence to its CWA Section 316(a) variance described in Section 3.6.3.2 would ensure that such effects would be minimized.

The SLR would continue current operating conditions and environmental stressors rather than introduce wholly new impacts. Therefore, the impacts of current operations and SLR would be similar. For these reasons, losses from predation, parasitism, and disease among organisms exposed to sublethal stresses would be minor and would neither destabilize nor noticeably alter any important attribute of aquatic populations during the SLR term. The NRC staff concludes that the impacts of losses from predation, parasitism, and disease among organisms exposed to sublethal stresses during the North Anna SLR term would be SMALL.

3.7.4 No-Action Alternative

If North Anna were to cease operating, impacts on the aquatic environment would decrease or stop following reactor shutdown. Some withdrawal of water from Lake Anna would continue during the shutdown period to provide cooling to spent fuel in the spent fuel pool until that fuel could be transferred to dry storage. The amount of water withdrawn for these purposes would be a small fraction of water withdrawals during operations, would decrease over time, and would likely end within the first several years following shutdown. The reduced demand for cooling water would substantially decrease the effects of impingement, entrainment, and thermal effluent on aquatic organisms, and these effects would wholly cease following the transfer of spent fuel to dry storage. Effects from cold shock would be unlikely, given the small area of lake affected by thermal effluent under normal operating conditions, combined with the phased reductions in withdrawal and discharge of lake water that would occur following shutdown.

The NRC staff concludes that the impacts of the no-action alternative on aquatic resources would be SMALL.

3.7.5 Replacement Power Alternatives: Common Impacts

Construction impacts for many components of either replacement power alternative would be qualitatively and quantitatively similar. Construction could result in aquatic habitat loss, alteration, or fragmentation; disturbance and displacement of aquatic organisms; mortality of aquatic organisms; and increase in human access. For instance, construction-related chemical spills, runoff, and soil erosion could degrade water quality in Lake Anna, its tributaries, or the

North Anna River by introducing pollutants and increasing sedimentation and turbidity. Dredging and other in-water work could directly remove or alter the aquatic environment and disturb or kill aquatic organisms. Because construction effects would be short term, associated habitat degradation would be relatively localized and temporary. Effects could be minimized by the use of existing infrastructure, such as the North Anna intake and discharge systems, as well as use of existing transmission lines, roads, parking areas, and certain existing buildings and structures on the site. Aquatic habitat alteration and loss could be minimized by siting components of the alternatives farther from waterbodies and away from drainages and other aquatic features.

Water quality permits required through Federal and State regulations would control, reduce, or mitigate potential effects on the aquatic environment. Through such permits, the permitting agencies could include conditions requiring Dominion to follow BMPs or to take certain mitigation measures if adverse impacts are anticipated. For instance, USACE oversees Section 404 permitting for dredge and fill activities, and VDEQ oversees VPDES permitting and general stormwater permitting. Dominion would likely be required to obtain each of these permits to construct a new replacement power alternative on the North Anna site. Notably, the EPA final rule under Phase I of the CWA Section 316(b) regulations applies to new facilities and sets standards to limit intake capacity and velocity to minimize impacts on fish and other aquatic organisms in the source water (40 CFR 125.84-TN254). Any new replacement power alternative subject to this rule would be required to comply with the associated technology standards.

With respect to operation of a new replacement power alternative, operational impacts for either alternative would be qualitatively similar but would vary in intensity, based on each alternative’s water use and consumption. Both alternatives would involve new nuclear power generation, in the form of SMRs. The new reactors would use mechanical draft cooling towers to dissipate waste heat. The NRC staff analyzed the impacts of operating cooling tower plants on the aquatic environment in the LR GEIS (NRC 2013-TN2654) and determined that operation of nuclear facilities with cooling towers would result in SMALL impacts on the aquatic environment, including those impacts resulting from impingement, entrainment, and thermal effluents. This is due to the relatively low volume of makeup water withdrawal for nuclear power plants with a cooling tower system and the minimal heated effluent that would be discharged. Water use conflicts would be unlikely, given that any new power alternative would be sited on the existing North Anna site and would consume a small fraction of the lake’s flow past the nuclear power plant.

3.7.6 New Nuclear (Small Modular Reactor) Alternative

The types of impacts that the aquatic environment would experience from this alternative are characterized in the previous section discussing impacts common to all replacement power alternatives. In that section, construction impacts are sufficiently addressed as they would apply to the new nuclear alternative. Based on that discussion, the NRC staff finds that impacts of construction would be SMALL because construction effects would be of limited duration, the new nuclear power plant would use some of the existing site infrastructure and buildings, and required Federal and State water quality permits would likely include conditions requiring BMPs and mitigation strategies to minimize environmental effects.

With respect to operation, Federal and State water quality permits would control and mitigate many of the potential effects on the aquatic environment, including water withdrawal and discharge, such that the associated effects would be unlikely to noticeably alter or destabilize any important attribute of the aquatic environment. The NRC staff finds that the impacts of operation of a new nuclear (SMR) alternative would be SMALL.

The NRC staff concludes that the impacts on aquatic resources from construction and operation of a new nuclear (SMR) alternative would be SMALL.

3.7.7 Combination Alternative (Solar, Offshore Wind, Small Modular Reactor, and Demand-Side Management)

The impacts of constructing the offshore wind component of this alternative would include increased turbidity, noise, vibration, and other physical disturbances to the aquatic environment from piledriving, turbine construction, and submarine power cable installation. Cable installation could disturb large spans of aquatic habitat and would be especially detrimental to nearshore and estuarine habitats used by early life stages of finfish and shellfish. Dredging would likely be necessary in some areas to prepare for cable installation and would result in destruction of the existing benthic habitat and temporary habitat loss until the benthic community could repopulate the area. Increased vessel anchoring during survey activities, construction, installation, and maintenance would increase turbidity and disturb the benthic environment. Accidental releases of contaminants from fuel and chemical spills would also pose a hazard to the aquatic environment and would be especially detrimental to nearshore, estuarine, and unique or sensitive habitats (BOEM 2020-TN7494). As explained under the discussion of impacts common to all alternatives, water quality permits required through Federal and State regulations would control, reduce, or mitigate potential effects on the aquatic environment. Through such permits, the permitting agencies could include conditions requiring Dominion to follow BMPs or to take certain mitigation measures if adverse impacts are anticipated. The impacts of construction of the offshore wind component of this alternative on aquatic resources would likely be MODERATE to LARGE, depending on the sensitivity and uniqueness of the particular aquatic habitats affected.

During operation of the offshore wind component of this alternative, fuel and chemical spills would remain a potential hazard. The presence of permanent structures could lead to impacts on finfish and aquatic invertebrates through entanglement from gear loss, hydrodynamic disturbance, fish aggregation, habitat conversion, and migration disturbances. These impacts may arise from buoys, meteorological towers, foundations, cable protection, and transmission cable infrastructure. However, structure-oriented or hard-bottom species could benefit from the new structures because they would have new material upon which to anchor themselves and build colonies (BOEM 2020-TN7494). The impacts of operation of this component of the alternative on aquatic resources would be SMALL to MODERATE, depending on the effectiveness of the measures implemented to control accidental releases of contaminants or to clean up such releases if they occur.

The impacts of constructing the solar photovoltaic component of this alternative are also addressed in the previous sections discussing impacts common to all alternatives. These effects would be SMALL to MODERATE, depending on the site(s) selected, the aquatic habitats present, and the extent to which construction would degrade, modify, or permanently alter those habitats. Operation of the solar photovoltaic component would have no discernable effects on the aquatic environment.

The types of impacts that the aquatic environment would experience from the SMR component of this alternative are characterized in the previous two sections discussing impacts common to all alternatives and impacts of the new nuclear alternative. Construction and operation impacts of this component of the combination alternative would be qualitatively similar. Because the nuclear component of the combination alternative would involve construction and operation of only one SMR, less cooling water would be required, which would result in fewer impacts on the aquatic environment. The impacts of construction and operation of this component of the alternative on aquatic resources would be SMALL.

The demand-side management component would have no discernable effects on the aquatic environment.

The NRC staff concludes that the impacts on aquatic resources from construction and operation of a combination alternative would be MODERATE to LARGE during construction and SMALL to MODERATE during operation. The higher magnitude of potential impacts experienced by the aquatic environment is primarily attributable to the offshore wind component of the alternative.

3.8 Special Status Species and Habitats

The NRC must consider the effects of its actions on ecological resources protected under several Federal statutes and must consult with the FWS or the National Oceanic and Atmospheric Administration (NOAA) prior to acting in cases where an agency action may affect those resources. These statutes include the following:

- ESA of 1973, as amended (16 U.S.C. § 1531 et seq.; TN1010)
- MSA, as amended by the Sustainable Fisheries Act of 1996 (16 U.S.C. § 1801 et seq.; TN7841)
- National Marine Sanctuaries Act (NMSA) (16 U.S.C. § 1431 et seq.; TN4482)

This section describes the species and habitats that are federally protected under these statutes and analyzes how the proposed license renewal and alternatives may affect these resources.

3.8.1 Endangered Species Act: Federally Listed Species and Critical Habitats

Congress enacted the ESA in 1973 to protect and recover imperiled species and the ecosystems upon which they depend. The ESA provides a program for the conservation of endangered and threatened plants and animals (collectively, “listed species”) and the habitats in which they are found. The FWS and National Marine Fisheries Service (NMFS) are the lead Federal agencies for implementing the ESA, and these agencies determine species that warrant listing. The following sections describe the North Anna action area and the species and habitats that may occur in the action area under each of the agencies’ jurisdictions.

3.8.1.1 Endangered Species Act: Action Area

The implementing regulations for Section 7(a)(2) of the ESA define “action area” as all areas affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02 TN4312). The action area effectively bounds the analysis of federally listed species and critical habitat s because only species and habitats that occur within the action area may be affected by the Federal action.

For the purposes of assessing the potential impacts of North Anna SLR on federally listed species, the NRC staff considers the action area to consist of the following.

North Anna Site: The terrestrial region of the action area consists of 1,043 ac (422 ha) within the North Anna site in Louisa County, Virginia. The site is situated on a peninsula on the southern shore of Lake Anna. It includes developed land to support power nuclear power plant operations (293 ac [119 ha]), deciduous forest (348 ac [141 ha]), evergreen forest (307 ac [124 ha]), mixed forest (17 ac [7 ha]), shrub/scrub (164 ac [66 ha]), woody wetlands (25 ac [10 ha]),and cultivated land (18 ac [7 ha]). Section 3.2 and Section 3.6 of this EIS describe the developed and natural features of the site and the characteristic vegetation and habitats.

Lake Anna: The aquatic region of the action area encompasses the impingement AOI (described in Section 3.7.3.1.1 of this EIS), the entrainment AOI (described in Section 3.7.3.1.2 of this EIS), the WHTF, and the area of Lake Anna that experiences increased temperatures from discharge of heated effluent at Outfall 001 (described in Section 3.6.3.2 of this EIS).

The NRC staff recognizes that although the described action area is stationary, federally listed species can move in and out of the action area. For instance, a migratory bird could occur in the action area seasonally as it forages or breeds within the action area. Thus, in its analysis, the NRC staff considers not only those species known to occur directly within the action area but those species that may passively or actively move into the action area. The NRC staff then considers whether the life history and habitat requirements of each species make it likely to occur in the action area where it could be affected by the proposed license renewal. The following sections first discuss listed species and critical habitat s under FWS jurisdiction, followed by those under NMFS jurisdiction.

3.8.1.2 Endangered Species Act: Federally Listed Species and Critical Habitats under FWS Jurisdiction

This section evaluates four species. Two are federally listed, one is proposed for listing under the ESA, and one is a candidate for listing. Table 3-18 lists each of these species and its federal status. The NRC staff determined these species to be relevant to this review based on desktop analysis of the North Anna action area, available scientific literature and studies, and the results of past ESA Section 7 consultations in connection with the North Anna site. No designated or proposed critical habitat occurs in the action area.

Table 3-18 Federally Listed Species Under FWS Jurisdiction Evaluated for North Anna Subsequent License Renewal

Common Name	Species	Federal Status[(a)]
northern long-eared bat	*Myotis septentrionalis*	FE
tricolored bat	*Perimyotis subflavus*	FPE
monarch butterfly	*Danaus plexippus*	FC
dwarf wedgemussel	*Alasmidonta heterodon*	FE

(a) Indicates protection status under the Endangered Species Act. FC = candidate for federal listing; FE = federally endangered; and FPE = proposed for Federal listing as endangered.

In 2002, as part of its environmental review for the initial North Anna license renewal term, the NRC evaluated the dwarf wedgemussel (NRC 2002-TN665). The NRC staff found no records indicating the presence of the species in the action area or in Lake Anna, its tributary streams, or the North Anna River near North Anna. Accordingly, the NRC staff concluded that the initial North Anna license renewal would not affect this species. In 2006 and 2010, the NRC addressed the dwarf wedgemussel in its environmental reviews for the North Anna ESP and COL (NRC 2006-TN8385; NRC 2010-TN6). The staff identified no new information indicating occurrences of the species in the vicinity of the North Anna site. During the current SLR review, the NRC staff has identified no additional information that would indicate the presence of the dwarf wedgemussel in the North Anna action area. Accordingly, this species is not considered in any further detail in this EIS.

Also as part of the NRC staff's environmental review for the initial license renewal, the staff considered two additional freshwater mussels: the Atlantic pigtoe (*Fusconala masoni*) (proposed threatened) and James spinymussel (*Pleurobema collina*) (federally endangered) (NRC 2002-TN665). The staff found that neither species had been observed in Lake Anna, in its tributary streams, or in the North Anna River near North Anna. Accordingly, the NRC staff concluded that the initial North Anna license renewal would not affect these species.

In 2006 and 2010, the NRC staff also addressed the Atlantic pigtoe and James spinymussel, as well as the green floater (federally under review), in its environmental reviews for the North Anna ESP and COL (NRC 2006-TN8385, NRC 2010-TN6). At that time, the NRC staff identified VDGIF records of the green floater occurring in the upper Pamunkey River watershed. However, the NRC staff identified no records of any of the three mussels occurring in the action area. During the current SLR review, the NRC staff has identified no additional information that would indicate the presence of these mussels in the North Anna action area. Accordingly, these species are not considered in any further detail in this EIS.

In its environmental review for the 2003 license renewal, the NRC staff evaluated the bald eagle and determined that license renewal would not affect this species. FWS subsequently delisted this species due to the species' recovery. The bald eagle remains federally protected under the Bald and Golden Eagle Protection Act, which is discussed in Section 3.5.4 of this EIS.

In 2009, 2010, and 2012, the Williamsburg Environmental Group, Inc. conducted botanical surveys on the North Anna site and alternative sites, in connection with Dominion's COL application, to determine the presence of the small whorled pogonia (*Isotria medeoloides*) (federally threatened). The surveys determined that the species was not present, and Dominion communicated its survey results to the appropriate regulatory agencies (Dominion 2016-TN8496).

The NRC staff has not evaluated the northern long-eared bat during previous environmental reviews of North Anna or the North Anna site because FWS did not list the species under the Endangered Species Act until 2015. Additionally, the staff has not evaluated the tricolored bat, which was proposed for listing in 2022, or the monarch butterfly, which became a candidate in 2020. Accordingly, the NRC staff addresses these species in this EIS and evaluates the potential effects of SLR on each species. The sections below describe the habitat requirements, life history, and regional occurrences of the northern long-eared bat, tricolored bat, and monarch butterfly.

<u>Northern Long-eared Bat</u>

The FWS listed the northern long-eared bat as threatened throughout its range in 2015 (80 FR 17974-TN4216). In 2016, FWS determined that designating critical habitat for the species was not prudent because such designation would increase threats to the species resulting from vandalism and disturbance and could potentially increase the spread of white-nose syndrome (81 FR 24707-TN8388). In 2022, the FWS reclassified this species as endangered with an effective date of January 30, 2023 (87 FR 73488-TN8545). Information in this section is organized according to the description of the species in the FWS *Federal Register* notice associated with the final rule to list the species (80 FR 17974-TN4216) and draws from this source unless otherwise indicated.

Taxonomy and Species Description

Although there have been few genetic studies on the northern long-eared bat, FWS describes it as a monotypic species (i.e., having no subspecies). This species has been recognized by different common names, including Keen's bat, northern Myotis, and the northern bat.

The northern long-eared bat is a medium-sized bat that is distinguished from other *Myotis* species by its long ears, which average 0.7 in. (17 mm) in length. Adults weigh 5 to 8 grams (0.2 to 0.3 ounces), and females tend to be slightly larger than males. Individuals are medium to dark brown on the back, dark brown on the ears and wing membranes, and tawny to pale brown on the ventral side. Within its range, the northern long-eared bat can be confused with the little brown bat or the western long-eared myotis (*M. evotis*).

Distribution and Relative Abundance

Species Range. The northern long-eared bat is found across much of the eastern and north-central United States and all Canadian provinces from the Atlantic coast to the southern Northwest Territories and eastern British Columbia. Its range includes 37 U.S. states. The species is widely distributed within the eastern portion of its range, which includes Delaware, Connecticut, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, Pennsylvania, Vermont, Virginia, West Virginia, New York, Rhode Island, and the District of Columbia. Before documentation of white-nose syndrome, northern long-eared bats were consistently captured during summer mist-net and acoustic surveys within this region. However, as white-nose syndrome has spread, growing gaps exist within the eastern region where bats are no longer being captured or detected. In other areas, occurrences are sparse. Frick et al. (2015-TN8497) documented the local extinction of northern long-eared bats from 69 percent of 468 sites where white-nose syndrome has been present for at least 4 years in Vermont, New York, Pennsylvania, Maryland, West Virginia, and Virginia, which was by far the highest extinction rate among six species of North American hibernating bats considered during the study.

Status Within Virginia. As of 2016, FWS reports 11 known northern long-eared bat hibernacula and 12 known occupied maternity roost trees in Virginia (FWS 2016-TN7400). Historically, the species has been captured in both summer and winter surveys within the State. However, since the appearance of white-nose syndrome in Virginia (2008–2009), winter and summer survey captures have sharply declined. In a 2015 environmental assessment associated with the northern long-eared bat final rule under Section 4(d) of the Endangered Species Act Section, FWS made the following estimates of Virginia's northern long-eared bat population (FWS 2015-TN8498):

- 277,920 total adults
- 138,960 total pups
- 6,948 maternity colonies of an average size of 20 individuals
- 48.3 percent occupancy of Virginia's available forested habitat
- 7.29 percent use of Virginia's available forested habitat as maternity roost areas

Habitat

Winter Habitat. Northern long-eared bats predominantly overwinter in hibernacula of various sizes that include underground caves and abandoned mines. Preferred hibernacula have relatively constant, cool temperatures with very high humidity and no air currents. Individuals most often roost in small crevices or cracks in cave or mine walls or ceilings but are also infrequently observed hanging in the open. Less commonly, northern long-eared bats overwinter in abandoned railroad tunnels, storm sewers, aqueducts, attics, and other non-cave or mine hibernacula with temperature, humidity, and air flow conditions resembling suitable caves and mines.

Summer Habitat. In summer, northern long-eared bats typically roost individually or in colonies underneath bark or in cavities or crevices of both live trees and snags. Males and nonreproductive females may also roost in cooler locations, including caves and mines. Individuals have also been observed roosting in colonies in buildings, barns, on utility poles, and in other human-made structures. The species has been documented to roost in many species of trees, including black oak (*Quercus velutina*), northern red oak (*Q. rubra*), silver maple (*Acer saccharinum*), black locust (*Robinia pseudoacacia*), American beech (*Fagus grandifolia*), sugar maple (*A. saccharum*), sourwood (*Oxydendrum arboreum*), and shortleaf pine (*Pinus echinata*). Foster and Kurta (1999-TN8499) found that, rather than being dependent on particular tree species, northern long-eared bats are likely to use a variety of trees as long as they form suitable cavities or retain bark. Owen et al. (2022-TN8500) found that tree-roosting maternal colonies chose roosting sites in larger trees that were taller than the surrounding stand and in areas with abundant snags. Carter and Feldhamer (2005-TN8501) indicate that resource availability drives roost tree selection more than the actual tree species. However, several studies have shown that the species more often roosts in shade-tolerant deciduous trees than in conifers. Additionally, the FWS concludes in its final listing that the tendency for northern long-eared bats to use healthy live trees for roosting is low.

Northern long-eared bats actively form colonies in the summer, but such colonies are often in flux because members will frequently depart to be solitary or to form smaller groups and later return to the main unit. This behavior is described as “fission-fusion,” and it also results in individuals often switching tree roosts (typically every 2 to 3 days). Roost trees are often near each other within the species’ summer range, with various studies documenting distances between roost trees ranging from 20 ft (6.1 m) to 2.4 mi (3.9 km).

Spring Staging. Spring staging is the period between winter hibernation and spring migration to summer habitat when bats begin to gradually emerge from hibernation. Individuals will exit the hibernacula to feed but reenter the same or alternative hibernacula to resume periods of physical inactivity. The spring staging period is believed to be short for the northern long-eared bat and may last from mid-March through early May, with variations in timing and duration based on latitude and weather.

Fall Swarming. Fall swarming is the period between the summer and winter seasons and includes behaviors such as copulation, introduction of juveniles to hibernacula, and stopovers at sites between summer and winter regions. Both males and females are present together at swarming sites, and other bat species are often present as well. For northern long-eared bats, the swarming period may occur between July and early October, depending on latitude within the species’ range. Northern long-eared bats may use caves and mines during swarming. Little is known about roost tree selection during this period, but some studies suggest that a wider variation in tree selection may occur during swarming than during the summer.

Roost Trees. Northern long-eared bats roost in cavities, crevices, hollows, or under the bark of live and dead trees and snags of greater than 3 in. (8 cm) diameter at breast height. Isolated trees may be considered suitable habitat when they exhibit these characteristics and are less than 1,000 ft (300 m) from the next nearest suitable roost tree within a wooded area. Northern long-eared bats appear to choose roost trees based on structural suitability rather than exhibiting a preference for specific species of trees.

Biology

Hibernation. Northern long-eared bats hibernate during winter months. Individuals arrive at hibernacula in August or September, enter hibernation in October and November, and emerge from hibernacula in March or April. The species has shown a high degree of repeated hibernaculum use, although individuals may not return to the same hibernacula in successive seasons. Northern long-eared bats often inhabit hibernacula in small numbers with other bat species, including little brown bats, big brown bats (*Eptesicus fuscus*), eastern small-footed bats (*Myotis leibii*), tricolored bats (*Perimyotis subflavus*), and Indiana bats (*M. sodalis*). Northern long-eared bats have been observed moving among hibernacula during the winter hibernation period, but individuals do not feed during this time, and the function of this behavior is not well understood.

Migration and Homing. Northern long-eared bats migrate relatively short distances (between 56 and 89 km [35 and 55 mi]) from summer roosts and winter hibernacula. The spring migration period typically occurs from mid-March to mid-May, and fall migration typically occurs between mid-August and mid-October.

Reproduction. Northern long-eared bats mate from late July in northern regions to early October in southern regions. Hibernating females store sperm until spring, and ovulation takes place when females emerge from hibernacula. Gestation is estimated to be 60 days, after which time females give birth to a single pup in late May or early June. Females raise their young in maternity colonies, which generally consist of 30 to 60 individuals (females and young). Roost tree selection changes depending on the reproductive stage, with lactating females roosting higher in tall trees with less canopy cover. Young are capable of flight as early as 3 weeks following birth. Maximum lifespan for northern long-eared bats is estimated to be up to 18.5 years, and the highest rate of mortality occurs during the juvenile stage.

Foraging Behavior. Northern long-eared bats are nocturnal foragers that use hawking and gleaning in conjunction with passive acoustic cues to collect prey. The species' diet includes moths, flies, leafhoppers, caddisflies, beetles, and arachnids. Individuals forage 1 to 3 m (3 to 10 ft) above the ground between the understory and canopy of forested hillsides and ridges, with peak foraging activity occurring within 5 hours after sunset.

Home Range. Northern long-eared bats exhibit site fidelity to their summer home range, during which time individuals roost and forage in forests. Studies indicate a variety of home range sizes—from as little as 8.6 ha (21.3 ac) to as large as 172 ha (425 ac). Some studies indicate differences in ranges between sexes, while others find no significant differences.

Factors Affecting the Species

FWS identifies white-nose syndrome, a disease caused by the fungus *Pseudogymnoascus destructans*, to be the predominant threat to the northern long-eared bat's continued existence. Other factors include human disturbance of hibernacula and loss of summer habitat due to forest conversion and forest management.

Occurrence Within the Action Area

The North Anna action area falls within the general range of the northern long-eared bat. However, no known hibernacula, roost trees, or summer habitat occur within the action area, according to VDGIF records (VDGIF 2023-TN8502). The closest hibernaculum or summer habitat is approximately 70 mi (112 km) west of the North Anna site in the Shenandoah Mountains (VDGIF 2023-TN8502).

In 2016, Dominion commissioned GAI Consultants, Inc. (GAI) to conduct mist-net surveys of the North Anna site in connection with the North Anna COL application (GAI 2016-TN8503). Researchers selected and operated nine net sites using three net sets operated between two and five nights each for a total of 84 net nights of effort, in accordance with FWS mist-net guidelines for nonlinear projects within the Appalachian Indiana Bat Recovery Unit. All mist-net sites were located within or immediately adjacent to the North Anna site. Sites included logging roads, abandoned railroad corridors, a stream, a forest edge, open forest interior, and forested trails. Habitat surrounding these sites was predominantly young and mature mixed forest, and common trees included tulip poplar (*Liriodendron tulipifera*), Virginia pine (*Pinus virginiana*), white oak (*Quercus alba*), red oak, and red maple (*Acer rubrum*).

Researchers set nets between May 16 and May 28, 2016, to correspond to the May 15 through August 15 summer habitat survey window prescribed by the FWS and VDGIF. A federally and State-permitted biologist identified all collected bats. An FWS-approved surveyor for bats in Virginia was also present throughout the survey. GAI collected a total of 29 bats of two species: 23 eastern red bats (*Lasiurus borealis*) and six silver-haired bats (*Lasionycteris noctivagans*). Because of the time of year that the survey was conducted, all individuals were adults. As a result of the survey, GAI found no evidence that northern long-eared bats use the project area during summer months. GAI concluded that the species is likely absent from the area or, if present, occurs rarely and in extremely small numbers.

Based on the above information, the NRC staff concludes that northern long-eared bats are not present in the action area in winter due to the lack of nearby hibernacula. Northern long-eared bats are also unlikely to occur in the action area in other seasons, based on the 2016 mist nest survey results and lack of VDGIF records. However, the NRC staff conservatively assumes that forests within the action area, which cover 672 ac (272 ha), could support foraging, mating, and sheltering in the spring, summer, and fall. If present during these seasons, individuals would only occur very occasionally and in very low numbers.

Tricolored Bat

The FWS issued a proposed rule to list the tricolored bat as endangered in 2022 (87 FR 56381-TN8546-TN8546). The FWS proposed no critical habitat with the rule because it found that such a designation could increase the degree of threat to the species. Information in this section is drawn from the FWS's species status assessment (FWS 2021-TN8589) unless otherwise cited.

The tricolored bat is a small insectivorous bat that can be distinguished by its unique tricolored fur, which often appears yellowish to orange. The species occurs across 39 states in the eastern and central United States and in portions of southern Canada, Mexico, and Central America. During the winter, tricolored bats often inhabit caves and abandoned mines. In the southern United States, where caves are sparse, tricolored bats also roost in road culverts where they exhibit shorter hibernation bouts and may leave hibernacula to forage during warm nights. Tricolored bats hibernate singly, but sometimes in pairs or in small clusters of both sexes away from other bats. Between mid-August and mid-October, males and females converge at cave and mine entrances to swarm and mate, and females typically give birth to two young between May and July.

Tricolored bats disperse from winter hibernacula to summer roosting habitat in the spring. Tracking studies have recorded migration paths that span from 27 mi (44 km) to 151 mi (243 km). During the spring, summer, and fall, tricolored bats occupy forested habitats. Individuals roost among leaves of live or recently dead deciduous hardwood trees, but individuals may also roost in pines (*Pinus* spp.), eastern red cedar (*Juniperus virginiana*), Spanish moss (*Tillandsia usneoides*), *Usnea trichodea* lichen, and occasionally human structures. Tricolored bats are opportunistic feeders and consume small insects including caddisflies (Trichoptera), flying moths (Lepidoptera), small beetles (Coleoptera), small wasps and flying ants (Hymenoptera), true bugs (Homoptera), and flies (Diptera).

Factors Affecting the Species

Tricolored bats face extinction due primarily to the range-wide impacts of white-nose syndrome, a deadly disease affecting cave-dwelling bats. The FWS estimates that white-nose syndrome has caused population declines of 90 percent or more in affected tricolored bat colonies across most of the species' range.

Occurrence Within the Action Area

The FWS (FWS 2023-TN9092) identified the tricolored bat as potentially occurring in the action area in the Information for Planning and Consultation (IPaC) report for the proposed action. Within Virginia, the species is found throughout the state in the summer months. Dominion reports no occurrences of tricolored bats on the North Anna site. However, Dominion has conducted no ecological surveys to specifically assess the species' presence or the suitability of onsite habitat.

Based on the above information, the NRC staff conservatively assumes that deciduous forest habitat within the action area could support foraging, mating, and sheltering in the spring, summer, and fall. Accordingly, the staff assesses the potential impacts of the proposed action on this species in Section 3.7.4 of this SEIS.

<u>Monarch Butterfly</u>

The monarch butterfly is a candidate for Federal listing. In 2020, the FWS issued a 12-month finding announcing its intent to prepare a proposed rule to list the monarch as threatened (85 FR 81813-TN8590). In 2022, the FWS identified the monarch listing action as a priority because the magnitude of threats is moderate to low; however, those threats are imminent for the eastern and western North American populations. Although the ESA does not require consultation for candidates, the NRC considers this species here at the recommendation of the FWS (FWS 2023-TN9092) in its IPaC report for the proposed project. Information in this section is drawn from the FWS's candidate review unless otherwise cited (87 FR 26152-TN8591).

The monarch is a large butterfly with bright orange wings and black veining and borders. During the breeding season, females lay eggs on milkweed (primarily *Asclepias* spp.). Developing larvae feed on milkweed, which allows them to sequester toxic chemicals as a defense against predators, before pupating into a chrysalis to transform into the adult butterfly form. Monarchs produce multiple generations each breeding season, and most adult butterflies live 2 to 5 weeks. Overwintering adults, however, enter reproductive diapause and live 6 to 9 months.

Monarch butterflies occur in 90 countries, islands, or island groups. Monarch butterflies have become naturalized at most of these locations outside of North America since 1840. The populations outside of eastern and western North America (including southern Florida) do not exhibit long-distance migratory behavior. In many regions, monarchs breed year-round. In temperate climates, such as eastern and western North America, monarchs migrate long distances and live for an extended period. In the fall, in both eastern and western North America, monarchs begin migrating to their respective overwintering sites in the forests of California and Mexico. These overwintering sites provide protection from the elements and moderate temperatures, as well as nectar and clean water sources located nearby. Migrations can be of distances of over 1,900 mi (3,000 km) and span a 2-month period. In early spring (February–March), surviving monarchs break diapause and mate at overwintering sites before dispersing. The same individuals that undertook the initial southward migration begin flying back through the breeding grounds, and their offspring re-start the cycle of generational migration.

Factors Affecting the Species

The primary threats to the monarch's biological status include loss and degradation of habitat from conversion of grasslands to agriculture, widespread use of herbicides, logging/thinning at overwintering sites in Mexico, senescence and incompatible management of overwintering sites in California, urban development, drought, exposure to insecticides, and effects of climate change.

Occurrence Within the Action Area

Monarchs are associated with prairie, meadow, and grassland habitats. In Virginia, swamp milkweed (*Asclepias incarnata*) leaves are critical for the development of monarch eggs and larvae. The plant's pink blossoms provide nectar from July through August. It is unknown whether milkweed occurs in this area, although grasslands within the action area are undeveloped and would remain undisturbed during the proposed license renewal period. The NRC staff conservatively assumes that monarchs could occur in the action area during spring and fall migration when individuals are moving between areas of more suitable habitat. Accordingly, the staff assesses the potential impacts of the proposed action on this species in Section 3.7.4 of this SEIS.

Summary of Potential Species Occurrence in the Action Area

Table 3-19 summarizes the potential for each federally listed, proposed, and candidate species mentioned in this section to occur in the action area.

3.8.1.3 Endangered Species Act: Federally Listed Species and Critical Habitats under National Marine Fisheries Service Jurisdiction

No federally listed species or designated critical habitats under NMFS jurisdiction occur in the action area. Therefore, this section of this EIS does not contain a discussion of any such species or habitats.

Table 3-19 Occurrences of Federally Listed Species in the Action Area under FWS Jurisdiction

Species	Type of and Likelihood of Occurrence in the Action Area
northern long-eared bat	Seasonal presence in spring, summer, and fall possible in very low numbers in action area forests of sufficient size to support foraging, mating, and sheltering.
tricolored bat	Presence possible in spring, summer, and fall in deciduous forest habitat within the action area.
monarch butterfly	Occasional transitory presence possible during spring and fall migration when individuals are moving between areas of more suitable habitat.
dwarf wedgemussel	Not present.
Atlantic pigtoe	Not present.
green floater	Not present.
James spineymussel	Not present.
small whorled pogonia	Not present.

3.8.2 Magnuson–Stevens Act: Essential Fish Habitat

Congress enacted MSA in 1976 to foster long-term biological and economic sustainability of U.S. marine fisheries. The MSA directs the fishery management councils, in conjunction with NMFS, to designate areas of EFH and to manage marine resources within those areas. The EFH is the coastal and marine waters and substrate necessary for fish to spawn, breed, feed, or grow to maturity (50 CFR 600.10, TN1342). For each federally managed species, the fishery management councils and NMFS designate and describe the EFH by life stage (i.e., egg, larva, juvenile, and adult). No coastal or marine waters occur near North Anna. Therefore, this EIS does not discuss EFH.

3.8.3 National Marine Sanctuaries Act: Sanctuary Resources

Congress enacted the NMSA in 1972 to protect areas of the marine environment that have special national significance. The NMSA authorizes the Secretary of Commerce to establish the National Marine Sanctuary System and designate sanctuaries within that system, which includes 15 sanctuaries and 2 marine national monuments, encompassing more than 600,000 square miles (3.84 million square acres) of marine and Great Lakes waters from Washington State to the Florida Keys, and from Lake Huron to American Samoa. Within these areas, sanctuary resources include any living or nonliving resource of a national marine sanctuary that contributes to the conservation, recreational, ecological, historical, educational, cultural, archaeological, scientific, or aesthetic value of the sanctuary. No coastal or marine waters or Great Lakes occur near North Anna. Therefore, this EIS does not discuss national marine sanctuaries or their resources.

3.8.4 Proposed Action

The following sections address the site-specific environmental impacts of North Anna SLR on the environmental issues identified in Table 3-1 that relate to special status species and habitats.

3.8.4.1 Endangered Species Act: Federally Listed Species and Critical Habitats under U.S. Fish and Wildlife Jurisdiction

In Section 3.8.1.2, the NRC staff determines that one listed species, one proposed species, and one candidate species may occur in the action area. These are the northern long-eared bat, tricolored bat, and monarch butterfly, respectively. Section 3.7.1.2 includes relevant information on the habitat requirements, life history, and regional occurrence of these species. In the sections below, the NRC staff analyzes the potential impacts of the proposed North Anna SLR on these species. Table 3-20 identifies the NRC staff's ESA effect determination that resulted from the staff's analysis.

In Section 3.8.1.2, the NRC staff also describes several other federally listed species that were addressed in previous NRC environmental reviews of North Anna or the North Anna site. The staff explains that these species do not occur in the action area. Table 3-20 identifies these species and the NRC's staff's "no effect" findings.

Table 3-20 Effect Determinations for Federally Listed Species under U.S. Fish and Wildlife Service Jurisdiction

Species	Federal Status[(a)]	Potentially Present in the Action Area?	Effect Determination[(b)]
northern long-eared bat	FE	Yes	NLAA
tricolored bat	FPE	Yes	NLAA
monarch butterfly	FC	Yes	NLAA
dwarf wedgemussel	FE	No	NE
Atlantic pigtoe	FT	No	NE
green floater	FC	No	NE
James spineymussel	FE	No	NE
small whorled pogonia	FT	No	NE

(a) Indicates protection status under the Endangered Species Act. FC = candidate for Federal listing; FE = federally endangered; FPE = proposed for Federal listing as endangered; FPT = proposed for Federal listing as endangered; and FT = federally threatened.
(b) The NRC staff makes its effect determinations for federally listed species in accordance with the language and definitions specified in the FWS and NMFS Endangered Species Consultation Handbook (FWS and NMFS 1998-TN1031). NLAA = May affect but is not likely to adversely affect; NE = no effect.

<u>Northern Long-Eared Bat and Tricolored Bat</u>

In Section 3.7.1.2 of this EIS, the NRC staff concludes that northern long-eared and tricolored bats may occur in the action area's forests in spring, summer, and fall. If present, these bats would occur rarely and in low numbers.

The potential stressors that northern long-eared and tricolored bats could experience from operation of a nuclear power plant (generically) are as follows.

- mortality or injury from collisions with nuclear power plant structures and vehicles
- habitat loss, degradation, disturbance, or fragmentation, and associated effects
- behavioral changes resulting from refurbishment or other site activities

This section addresses each of these stressors below.

Mortality or Injury from Collisions with Nuclear Power Plant Structures and Vehicles

Several studies have documented bat mortality or injury resulting from collisions with human-made structures. Saunders (1930-TN8504) reported that five bats of three species—eastern red bat, hoary bat (*L. cinereus*), and silver-haired bat—were killed when they collided with a lighthouse in Ontario, Canada. In Kansas, Van Gelder (1956-TN8505) documented five eastern red bats that collided with a television tower. In Florida, Crawford and Baker (1981-TN8506) collected 54 bats of seven species that collided with a television tower over a 25 year period; Zinn and Baker (1979-TN8507) reported 12 dead hoary bats at another television tower over an 18-year period, and Taylor and Anderson (1973-TN8508) reported 1 dead yellow bat (*Lasiurus intermedius*) at a third Florida television tower. Bat collisions with communications towers have been reported in North Dakota, Tennessee, and Saskatchewan, Canada; with convention center windows in Chicago, IL; and with power lines, barbed wire fences, and vehicles in numerous locations (Johnson and Strickland 2003-TN8509).

More recently, bat collisions with wind turbines have been of concern in North America. Bat fatalities have been documented at most wind facilities throughout the United States and Canada (USGS 2016-TN8510). For instance, during a 1996–1999 study at the Buffalo Ridge wind power development project in Minnesota, Johnson et al. (2003-TN8511) reported 183 bat fatalities, most of which were hoary bats and eastern red bats. The USGS Fort Collins Science Center estimates that tens to hundreds of thousands of bats die at wind turbines in North America each year (USGS 2016-TN8510).

Bat collisions with human-made structures at nuclear power plants are not well documented but are likely rare, based on the available information. In an assessment of the potential effects of operation of the Davis-Besse Nuclear Power Station in Ohio, the NRC staff (NRC 2014-TN7385) noted that four dead bats were collected at the nuclear power plant during bird mortality studies conducted from 1972 through 1979. Two red bats (*Lasiurus borealis*) were collected at the cooling tower, and one big brown bat and one tricolored bat were collected near other nuclear power plant structures. The NRC staff (NRC 2014-TN7385) found that future collisions of bats would be extremely unlikely and, therefore, discountable, given the small number of bats collected during the study and the marginal suitable habitat that the nuclear power plant site provides. The FWS (2014-TN7605) concurred with this determination. In a 2015 assessment associated with Indian Point Nuclear Generating Units 2 and 3, in New York, the NRC staff (NRC 2015-TN7382) determined that bat collisions were less likely to occur at Indian Point than at Davis-Besse because Indian Point does not have cooling towers or similarly large obstructions. The tallest structures on the Indian Point site are 134-ft (40.8-m)-tall turbine buildings and 250-ft (76.2-m)-tall reactor containment structures. The NRC staff (NRC 2015-TN7382) concluded that the likelihood of bats colliding with these and other nuclear power plant structures on the Indian Point site during the license renewal period was extremely unlikely to occur and, therefore, discountable. FWS concurred with this determination (FWS 2015-TN7612). In 2018, the NRC staff (NRC 2018-TN7381) determined that the likelihood of bats colliding with site buildings or structures on the Seabrook Station, Unit 1, site in New Hampshire would be extremely unlikely. The tallest structures on that site are the 199-ft (61-m)-tall containment structure and the 103-ft (31-m)-tall turbine and heater bay building. The FWS (FWS 2018-TN7610) concurred with the NRC staff’s determination. Most recently, the NRC staff (NRC 2020-TN7324) determined that the likelihood of bats colliding with site buildings or structures on the Surry Power Station, Units 1 and 2, site in Surry, Virginia, would be extremely unlikely. The FWS (FWS 2019-TN7609) again concurred with the NRC staff’s determination on the premise that activities associated with that license renewal would be consistent with the activities analyzed in the FWS programmatic biological opinion dated January 5, 2016 (FWS 2016-TN7400).

On the North Anna site, the tallest site structures are the reactor containment buildings, each of which is 191 ft (58 m) high (VEPCO 2020-TN8099). The turbine buildings and transmission lines are also prominent features on the site. To date, Dominion has reported no incidents of injury or mortality of any species of bat on the North Anna site associated with site buildings or structures. Accordingly, the NRC staff finds the likelihood of future northern long-eared bat collisions with site buildings or structures to be extremely unlikely and, therefore, discountable.

Vehicle collision risk for bats varies depending on factors including time of year, location of roads and travel pathways in relation to roosting and foraging areas, the characteristics of individuals' flight, traffic volume, and whether young bats are dispersing. Although collision has been documented for several species of bats, the Indiana Bat Draft Recovery Plan (FWS 2007-TN934) indicates that bat species do not seem to be particularly susceptible to vehicle collisions. However, the FWS also finds it difficult to determine whether roads pose a greater risk for bats colliding with vehicles or a greater likelihood of decreasing risk of collision by deterring bat activity (FWS 2016-TN7400). In most cases, the FWS expects that roads of increasing size decrease the likelihood of bats crossing the roads and, therefore, reduce collision risk (FWS 2016-TN7400).

During the proposed North Anna SLR term, vehicular traffic from truck deliveries, site maintenance activities, and personnel commuting to and from the site would continue throughout the license renewal period as they have during the current licensing period. Vehicle use would occur primarily in areas that bats would be less likely to frequent, such as along established county and State roads or within industrial-use areas of the North Anna site. Additionally, most vehicle activity would occur during daylight hours when bats are less active. To date, Dominion has reported no incidents of injury or mortality of any species of bat on the North Anna site associated with vehicle collisions. Accordingly, the NRC staff finds the likelihood of future northern long-eared or tricolored bat collisions with vehicles to be extremely unlikely and, therefore, is not considered further.

Habitat Loss, Degradation, Disturbance, or Fragmentation, and Associated Effects

As previously discussed in this EIS, the North Anna action area includes forested habitat that northern long-eared bats may rarely to very occasionally inhabit in spring, summer, and fall. In its final rule listing the northern long-eared bat (80 FR 17974-TN4216), the FWS stated that forest conversion and forest modification from management are two of the most common causes of habitat loss, degradation, disturbance, or fragmentation affecting the species. Forest conversion is the loss of forest to another land use type, such as cropland, residential, or industrial. Forest conversion can affect bats in the following ways (80 FR 17974-TN4216):

- loss of suitable roosting or foraging habitat
- fragmentation of remaining forest patches, leading to longer flights between suitable roosting and foraging habitat
- removal of travel corridors, which can fragment bat colonies and networks
- direct injury or mortality during active forest clearing and construction

Forest management practices maintain forest habitat at the landscape level, but they involve practices that can have direct and indirect effects on bats. Impacts from forest management are typically temporary in nature and can include positive, neutral, and negative impacts, such as the following (80 FR 1974-TN4216):

- maintaining or increasing suitable roosting and foraging habitat within the species' home range (positive)

- removing trees or small areas of forest outside of the species' summer home range or away from hibernacula (neutral)
- removing potential roost trees within the species' summer home range (negative)
- performing management activities near hibernacula that could disturb hibernating bats (negative)
- direct injury or mortality during forest clearing (negative)

Concerning forest conversion and its effects, the proposed action would not involve forest conversion or other activities that could result in similar impacts. Accordingly, bats would not experience the effects identified above and associated with forest conversion from the proposed action.

Concerning forest management, the proposed action would not involve forest management specifically. However, Dominion would continue to perform vegetation maintenance on the site over the course of the proposed SLR term. Most maintenance would be of grassy, mowed areas between buildings and along walkways within the industrial portion of the site or on adjacent hillsides. Dominion would continue to maintain onsite transmission line ROWs in accordance with North American Electric Reliability Corporation standards. Less-developed areas and forested areas would be largely unaffected during the license renewal term. Dominion does not intend to expand the existing facilities or otherwise perform construction or maintenance activities within these areas (VEPCO 2020-TN8099). Site personnel may occasionally remove select trees around the margins of existing forested areas if those trees are deemed hazardous to buildings, infrastructure, or other site facilities or to existing overhead clearances (VEPCO 2020-TN8099). Negative impacts on bats could result if such trees are potential roost trees. Bats could also be directly injured during tree clearing. However, tree removal would be infrequent, and Dominion personnel would follow company guidance (VEPCO 2020-TN8099), as explained below, to minimize potential impacts on bats.

Dominion requires its personnel and contractors to consider potential impacts on northern long-eared bats before site maintenance activities involving tree clearing. Dominion maintains companywide guidance that specifies how its personnel should proceed, depending on the type of tree clearing or site maintenance being performed. This guidance is summarized below for hazardous tree removal, existing ROW maintenance and expansion, clearing of less than or equal to 10 ac (4 ha) of trees, and clearing of greater than 10 ac (4 ha) of trees that are not in or adjacent to an existing ROW.

Hazardous Tree Removal. The FWS ESA 4(d) rule for the northern long-eared bat (81 FR 1900-TN8389) does not prohibit or restrict hazardous tree removal to protect human life or property. Before undertaking hazardous tree removal, Dominion documents its determination that the action meets the FWS definition of hazardous tree removal. Dominion does not specifically coordinate with FWS for such activities but avoids clearing hazardous trees during the brooding season in June and July.

Existing Right-of-Way Maintenance and Expansion. The FWS northern long-eared bat ESA 4(d) rule does not prohibit routine maintenance and expansion of up to 100 ft (30 m) from either edge of an existing ROW, as long as the project does not occur within 0.25 mi (0.4 km) of a known hibernaculum, does not involve cutting of known maternity roost trees in June or July, and does not involve clear-cutting within 0.25 mi (0.4 km) of known maternity roost trees in June or July. Before undertaking existing ROW maintenance and expansion, Dominion personnel review previously conducted bat surveys in the project area. If there are none, Dominion coordinates with the applicable FWS field office or the State resource agency, as appropriate. If known roost trees or hibernacula occur within 0.25 mi (0.4 m) of the project area, Dominion does not perform clearing in June or July without prior coordination with the FWS. If surveys have been conducted and those surveys identify no maternity roost trees, Dominion does not coordinate with the FWS before undertaking the activity.

Clearing of Less Than or Equal to 10 Acres of Trees. The FWS Gloucester, Virginia, field office interprets the northern long-eared bat 4(d) rule to not prohibit projects resulting in less than or equal to 10 ac (4 ha) of tree clearing if those projects are outside of certain location restrictions. For such projects, Dominion follows the process described above for maintenance of existing ROWs and expansion of ROWs before undertaking tree clearing.

Clearing of Greater Than 10 Acres of Trees That Are Not in or Adjacent to an Existing ROW. The FWS Gloucester, Virginia, field office interprets the northern long-eared bat ESA 4(d) rule to prohibit all projects not occurring in or adjacent to an existing ROW and resulting in greater than 10 ac (4 ha) of tree clearing that may affect the species. For such projects, Dominion requires its personnel to coordinate with the FWS before undertaking such a project. The company recognizes that FWS will likely require habitat surveys or acoustic or mist-net bat surveys for such projects with clearing planned between April 15 and September 15, if such surveys have not been completed within the past 5 years. If surveys do not identify suitable bat habitat or bats on the project site, and the FWS agrees with the survey results, Dominion does not restrict clearing to a particular time of year. If surveys identify bats on the project site, Dominion restricts clearing to between September 16 and April 14. Alternately, Dominion may coordinate with the FWS to determine if there are options that would allow clearing in the spring and summer. Dominion recognizes that State resource agencies may have additional requirements related to surveys or development of habitat conservation plans for which coordination may be necessary.

The NRC staff finds that the measures summarized above, in addition to the infrequency with which hazardous trees would likely be removed in forested areas, would not measurably affect any potential spring staging, summer roosting, or fall swarming habitat in the action area. Direct injury or mortality to bats during tree removal is also unlikely because Dominion company guidance would ensure that personnel take the appropriate measures to avoid this potential impact. For instance, Dominion could avoid this impact by removing hazardous trees in the winter when bats are unlikely to be present on the site. Additionally, the continued preservation of the existing forested areas on the site during the SLR term would result in positive impacts on northern long-eared and tricolored bats if they are present within or near the action area.

Behavioral Changes Resulting from Refurbishment or Other Site Activities

Construction or refurbishment and other site activities, including site maintenance and infrastructure repairs, could prompt behavioral changes in bats. Noise and vibration and general human disturbance are stressors that may disrupt normal feeding, sheltering, and breeding activities (FWS 2016-TN7400). At low noise levels or farther distances, bats initially may be startled but would likely habituate to the low background noise levels. At closer range and louder noise levels, particularly if accompanied by physical vibrations from heavy machinery, many bats would likely be startled to the point of fleeing from their daytime roosts. Fleeing individuals could experience increased susceptibility to predation and would expend increased levels of energy, which could result in decreased reproductive fitness (FWS 2016-TN7400, Table 4-1). Increased noise may also affect foraging success. Schaub et al. (2008-TN8867) found that the foraging success of the greater mouse-eared bat (*Myotis myotis*) diminished in areas with noise mimicking the traffic sounds that would be experienced within 15 m (49 ft) of a highway.

Within the North Anna action area, noise, vibration, and other human disturbances could dissuade bats from using the action area’s forested habitat during migration, which could also reduce the fitness of migrating bats. However, bats that use the action area have likely become habituated to such disturbance because North Anna has been consistently operating for several decades. According to the FWS, bats that are repeatedly exposed to predictable, loud noises may habituate to such stimuli over time (FWS 2010-TN8537). For instance, Indiana bats have been documented as roosting within approximately 1,000 ft (300 m) of a busy State route adjacent to Fort Drum Military Installation and immediately adjacent to housing areas and construction activities on the installation (U.S. Army 2014-TN8512). Northern long-eared and tricolored bats would likely respond similarly.

Continued operation of North Anna during the SLR term would not include major construction or refurbishment and would involve no other maintenance or infrastructure repair activities besides routine activities already performed on the site. Levels and intensity of noise, lighting, and human activity associated with continued day-to-day activities and site maintenance during the SLR term would be similar to ongoing conditions since North Anna began operating, and such activity would only occur on the developed, industrial-use portions of the site. While these disturbances could cause behavioral changes in migrating or summer roosting bats, such as the expenditure of additional energy to find alternative suitable roosts, the NRC staff assumes that northern long-eared bats, if present in the action area, have already acclimated to regular site disturbances. Thus, continued disturbances during the SLR term would not cause behavioral changes in bats to a degree that would be able to be meaningfully measured, detected, or evaluated or that would reach the scale where a take might occur.

Summary of Effects

The potential stressors evaluated in this section are unlikely to result in effects on the northern long-eared and tricolored bat that could be meaningfully measured, detected, or evaluated, and such stressors are otherwise unlikely to occur for the following reasons:

- Bat collisions with nuclear power plant structures in the United States are rare, and none have been reported at North Anna. Vehicle collisions attributable to the proposed action are also unlikely, and none have been reported at North Anna.
- The proposed action would not involve any construction, land clearing, or other ground-disturbing activities.
- Continued preservation of the existing forested areas on the site would result in positive impacts on bats.
- Bats, if present in the action area, have likely already acclimated to the noise, vibration, and general human disturbances associated with site maintenance, infrastructure repairs, and other site activities. During the SLR term, such disturbances and activities would continue at current rates and would be limited to the industrial-use portions of the site.

Conclusion for the Northern Long-eared Bat

All potential effects on the northern long-eared bat resulting from the proposed action would be insignificant or discountable. Therefore, the NRC staff concludes that the proposed action *may affect but is not likely to adversely affect* the northern long-eared bat.

In a letter dated October 26, 2020, the FWS concurred with this determination based on the premise that activities associated with the proposed SLR with the potential to affect the northern long-eared bat are consistent with the activities analyzed in the FWS January 5, 2016, programmatic biological opinion (FWS 2016-TN7400, FWS 2020-TN8592). On July 10, 2023, the NRC staff obtained an updated concurrence from the FWS based on the FWS's revised IPaC Determination Key for the northern long-eared bat (FWS 2023-TN9093). In a July 10, 2023, letter FWS documents that the NRC staff has fulfilled its ESA Section 7(a)(2) obligations with respect to the proposed North Anna SLR. The NRC staff notes that ESA regulations at 50 CFR 402.16 prescribe certain circumstances that require Federal agencies to reinitiate consultation. As of the date of issuance of this EIS, the NRC staff has identified no information that would warrant re-initiation of consultation (TN4312).

Conclusion for the Tricolored Bat

All potential effects on the tricolored bat resulting from the proposed action would be insignificant or discountable. Therefore, the NRC staff concludes that the proposed action may affect but is not likely to adversely affect the tricolored bat. Following the issuance of this EIS, the NRC staff will seek the FWS's concurrence regarding this finding.

Monarch Butterfly

In Section 3.7.1.2 of this SEIS, the NRC staff concludes that monarch butterflies may occur in the action area during spring and fall migration when individuals are moving between areas of more suitable habitat. If present, monarchs would occur occasionally and for short periods of time.

The FWS (2020-TN8593) identifies the primary drivers affecting the health of the two North American migratory populations of monarchs as (1) habitat loss and degradation, (2) insecticide exposure, and (3) climate change effects.

Monarch habitat loss and degradation has resulted from conversion of grasslands to agriculture, widespread use of herbicides, logging/thinning at overwintering sites in Mexico, senescence and incompatible management of overwintering sites in California, urban development, and drought (FWS 2020-TN8593). The proposed North Anna SLR would not involve any habitat loss, land-disturbing activities, or any activities that would degrade existing natural areas or potential habitat for monarch butterflies. The continued preservation of existing natural areas on the site would result in positive impacts on monarchs.

Most insecticides are non-specific and broad-spectrum in nature. Furthermore, the larvae of many Lepidopterans are considered major pest species, and insecticides are specifically tested on this taxon to ensure that they will effectively kill individuals at the labeled application rates (FWS 2020-TN8593). Although insecticide use is most often associated with agricultural production, any habitat where monarchs are found may be subject to insecticide use. Studies looking specifically at dose-response of monarchs to neonicotinoids, organophosphates, and pyrethroids have demonstrated monarch toxicity (e.g., Krischik et al. 2015-TN8596; James 2019-TN8595; Krishnan et al. 2020-TN8597; Bagar et al. 2020-TN8594). Moreover, the magnitude of risk posed by insecticides may be underestimated, as research usually examines the effects of the active ingredient alone, while many of the formulated products contain more than one active insecticide.

During the proposed SLR period, Dominion would continue applying herbicides, as needed, according to labeled uses. Application would primarily be confined to industrial-use and other developed portions of the site, such as perimeters of parking lots, roads, and walkways. Continued herbicide application could directly affect monarchs in the action area by injuring or killing individuals exposed to these chemicals. Certain herbicides, such as glyphosate (e.g., Round Up) can kill milkweed, which can affect the ability of female monarchs to lay eggs. However, milkweed is not specifically known to occur on the North Anna site, and Dominion has no plans to apply herbicides to natural areas. Additionally, monarchs are only likely to occur in the action area seasonally during spring and fall migration when individuals are moving between areas of more suitable habitat. Because of the low likelihood of monarchs to be exposure to levels of hazardous chemicals, this potential impact is insignificant because it is unlikely to reach the scale where a take might occur.

Because the current and projected monarch population numbers are low, both the eastern and western populations are more vulnerable to catastrophic events, such as extreme storms at the overwintering habitat, and other climate change related phenomena. The FWS (2020-TN8593) anticipates that the eastern population will gain habitat in the northcentral region of North America as the species expands northward in response to increasing ambient temperatures. The degree and rate of which this expansion occurs will depend on the simultaneous northward expansion of milkweed. In the southern region of the continent, including Texas, the population will either experience no gain or some loss of habitat.

Impacts on climate change during normal operations at nuclear power plants can result from the release of GHGs from stationary combustion sources, refrigeration systems, electrical transmission and distribution systems, and mobile sources. However, such emissions are typically very minor because nuclear power plants do not normally combust fossil fuels to generate electricity. During the proposed SLR term, the contribution of North Anna operations to climate change-related effects on monarchs would be too small to be meaningfully measured, detected, or evaluated.

Summary of Effects

The potential stressors evaluated in this section are unlikely to result in effects on the monarch butterfly that could be meaningfully measured, detected, or evaluated, and such stressors are otherwise unlikely to occur for the following reasons:

- The proposed action would not involve any habitat loss, land-disturbing activities, or any activities that would degrade existing natural areas or potential habitat for monarchs.
- Continued preservation of the existing natural areas on the site would result in positive impacts on monarchs.
- Herbicides would only be applied according to labeled uses in developed and manicured areas of the site. Herbicides would not be applied in natural areas. Monarchs would only have to potential to occur in the action area seasonally and infrequently, making the likelihood of herbicide exposure low. This represents an insignificant effect because it is unlikely to reach the scale where a take might occur.
- The contribution of North Anna operations to climate change-related effects on monarchs would be too small to be meaningfully measured, detected, or evaluate.

Conclusion for the Monarch Butterfly

All potential effects on the monarch butterfly resulting from the proposed action would be insignificant. Therefore, the NRC staff concludes that the proposed action *may affect but is not likely to adversely affect* monarchs. Because the monarch is a candidate for Federal listing, the ESA does not require the NRC to consult with the or receive concurrence from the FWS regarding this species.

3.8.4.2 Endangered Species Act: Federally Listed Species and Critical Habitats under NMFS Jurisdiction

No federally listed species or critical habitats under NMFS jurisdiction occur within the action area (see Section 3.7.1.3). Therefore, the NRC staff concludes that the proposed action would have no effect on federally listed species or habitats under this agency's jurisdiction.

3.8.4.3 Endangered Species Act: Cumulative Effects

The ESA regulations at 50 CFR 402.12(f)(4) direct Federal agencies to consider cumulative effects as part of the proposed action effects analysis (TN4312). Under the ESA, cumulative effects are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02 TN4312). Cumulative effects under the ESA do not include past actions or other Federal actions requiring separate ESA Section 7 consultation, which differs from the definition of "cumulative impacts" under NEPA.

When formulating biological opinions under formal ESA Section 7 consultation, the FWS and the NMFS (FWS and NMFS 1998) consider cumulative effects when determining the likelihood of jeopardy or adverse modification. Therefore, cumulative effects need only be considered under the ESA if listed species will be adversely affected by the proposed action and formal Section 7 consultation is necessary (FWS 2017-TN5753). Because the NRC staff concluded earlier in this section that the proposed SLR is not likely to adversely affect any federally listed species and would not destroy or adversely modify designated critical habitats, the NRC staff did not separately consider cumulative effects for the listed species and designated critical habitats. Further, the NRC staff did not identify any actions within the action area that meet the definition of cumulative effects under the ESA.

3.8.4.4 Magnuson–Stevens Act: Essential Fish Habitat

No EFH occurs within the affected area (see Section 3.8.4.4). Therefore, the NRC staff concludes that the proposed action would have no effect on EFH.

3.8.4.5 National Marine Sanctuaries Act: Sanctuary Resources

No National Marine Sanctuaries occur within the affected area (see Section 3.8.4.5). Therefore, the NRC staff concludes that the proposed action would have no effect on sanctuary resources.

3.8.5 No-Action Alternative

Under the no-action alternative, the NRC would not issue a renewed license, and North Anna would shut down on or before the expiration of the current renewed facility operating licenses. Upon shutdown, the nuclear power plant would require substantially less cooling water and would produce little to no discernable thermal effluent. Thus, the potential for impacts on all aquatic species related to cooling system operation would be significantly reduced. The ESA action area under the no-action alternative would most likely be the same or similar to the area described in Section 3.8.1.1. Northern long-eared bats, tricolored bats, and monarch butterflies may occur within the action area (see Section 3.7.1.2). The NRC would consult with the FWS, as appropriate, to address potential effects to these species resulting from shutdown and decommissioning of the plant. No EFH or national marine sanctuaries occur in the region (see Sections 3.7.2 and 3.7.3). Thus, shutdown would not result in impacts on EFH or sanctuary resources. Actual impacts would depend on the specific shutdown activities and whether any listed species or critical habitats are present when the no-action alternative is implemented.

3.8.6 Replacement Power Alternatives: Common Impacts

The ESA action area and waters potentially containing designated EFH or national marine sanctuary resources for any of the replacement alternatives would depend on various factors, including site selection, current land uses, planned construction activities, temporary and permanent structure locations and parameters, and the timeline of the alternative. The listed species, critical habitats, EFH, and national marine sanctuaries potentially affected by a replacement power alternative would depend on the boundaries of that alternative's effects and the species and habitats federally protected at the time the alternative is implemented. For instance, if North Anna continues to operate until the end of the current license terms and a replacement power alternative is implemented at that time, the FWS and NMFS may have listed new species, delisted currently listed species whose populations have recovered, or revised EFH designations. These listing and designation activities would change the potential for the various alternatives to impact federally protected ecological resources. Additionally, requirements for consultation under ESA, MSA, and NMSA would depend on whether Federal permits or authorizations are required to implement each alternative.

Sections 3.5.5 and 3.7.6 describe the types of impacts that terrestrial and aquatic resources would experience under each alternative. Impacts on federally protected ecological resources would likely be similar in type. However, the magnitude and significance of such impacts could be greater for federally protected ecological resources because such species and habitats are rare and more sensitive to environmental stressors.

3.8.7 New Nuclear (Small Modular Reactor) Alternative

The impacts of the new nuclear alternative are largely addressed in the impacts common to all replacement power alternatives described in the previous section. Because the NRC would remain the licensing agency under this alternative, the ESA, MSA, and NMSA would require the NRC to consult with the FWS, NMFS, and NOAA, as applicable, before issuing a license for construction and operation of the new facility. During these consultations, the agencies would determine whether the new reactors would affect any federally listed species, adversely modify or destroy designated critical habitat, or result in adverse effects on EFH or sanctuary resources. If the new facility requires a CWA Section 404 permit, the USACE may be a cooperating agency for required consultations, or it may be required to consult separately. Ultimately, the magnitude and significance of adverse impacts on special status species and habitats would depend on the site location and layout, plant design, plant operations, and the protected species and habitats present in the area when the alternative is implemented.

3.8.8 Combination Alternative (Solar, Offshore Wind, Small Modular Reactor, and Demand-Side Management)

Section 3.8.5 addresses the impacts of the SMR component of this alternative The NRC does not license solar photovoltaic or wind facilities or play a role in energy-planning decisions. Therefore, the NRC would not be responsible for consultations with the FWS, NMFS, and NOAA for these components of the alternative. The Federal and private responsibilities for addressing impacts on federally protected ecological resources under these components of this alternative would be similar to those described in Section 3.7.4. Ultimately, the magnitude and significance of adverse impacts on federally protected ecological resources resulting from the combination alternative would depend on the site locations, layouts, design specifications, and operations of the components of this alternative, as well as the species and habitats present in the area when each component of the alternative is implemented.

3.9 Historic and Cultural Resources

This section describes the cultural background and the historic and cultural resources found at North Anna and in the surrounding area. The description of the resources is followed by the staff's analysis of the potential impacts on historic and cultural resources from the proposed action (SLR) and alternatives to the proposed action.

3.9.1 Cultural Background

Section 2.2.9.1 of NUREG-1437, Supplement 7, and Section 2.9.1 of NUREG-1811, describe the cultural background (history) of the North Anna site and vicinity (NRC 2002-TN665: p. 2-45, 2-46; NRC 2006-TN8385: p. 2-72, 2-73). A similar description is presented in Section E3.8.2 of Dominion's ER (VEPCO 2020-TN8099: Section E3.8.2, p. E-3-192 through E-3-194). This information is incorporated here by reference and summarized below. The NRC staff's environmental review identified no other new and significant information during the site audit, the scoping process, or the evaluation of other available information.

The North Anna site and surrounding area exhibit evidence of both prehistoric and historic occupation by Native Americans and Euro-Americans. Archaeological records suggest that this region was potentially occupied by Native American populations during the Paleoindian Period (before 8000 BC), the Archaic Period (about 8000 BC to 1200 BC), and the Woodland Period (about 1200 BC to AD 1600) (VEPCO 2020-TN8099: Section E3.8.1).

At the time of European contact and subsequent movement into the area surrounding North Anna, the lands, including the piedmont and mountains of western Virginia, were occupied by several Siouan-speaking Indian groups. One of the Monacan Indian groups, part of the larger Monacan Confederacy, is commonly associated with the area of present-day Louisa County (NRC 2002-TN665).

European settlement of the area around the North Anna site began shortly after 1700 AD. The earliest nonnative economy of the area was based on growing tobacco in the fertile lands along the North and South Anna River valleys. In the early 1800s, production of tobacco resulted in severe soil exhaustion, and wheat and corn replaced it as staple crops. Although the area remained largely rural and agricultural, mining and quarrying became important to the economy of Louisa County with the discovery of gold in western Spotsylvania County in 1806. Iron, copper, sulfur, gold, and other ores were mined, and whetstone materials were quarried. Although most of the local gold mines closed by 1865 after exhausting the most accessible deposits, the area just upriver from North Anna remained the scene of intensive gold mining from about 1830 to 1900. Agriculture continued to be the main economic focal point through the mid-twentieth century, with timber mills becoming increasingly important (VEPCO 2020-TN8099: Section E3.8.2; NRC 2002-TN665).

3.9.2 Historic and Cultural Resources at North Anna

Similar to the description of the cultural history, Section 2.2.9.2 of NUREG-1437, Supplement 7, and Section 2.9.1 of NUREG-1811, describe the survey of historic records to identify potential historic and cultural resources that may be present at the North Anna site (NRC 2002-TN665:

p. 2-47; NRC 2006-TN8385: p. 2-74 and 2-75). Dominion's ER presents a similar description (VEPCO 2020-TN8099: Sections E3.8 through E3.8.5, p. E-189 through E-3-196). This information is incorporated here by reference and summarized below.

No documented cultural resources surveys were conducted of the North Anna site prior to construction of the nuclear power plant. Reconnaissance-level historic and archaeological investigations completed in 1969 and 1970 for both the North Anna site area and the lakebed area yielded few results. In addition, 33 historic period cemeteries were identified in the area along the river to be inundated. Many of these were avoided by adjusting project boundaries, although some were "removed" prior to inundation (VEPCO 2020-TN8099; NRC 2006-TN8385).

Cultural resource surveys of the North Anna property were conducted in 2001 to support initial license renewal, with additional surveys being conducted in 2003, 2006, and 2007. Five cultural resource sites have been recorded within the North Anna site boundaries:

- The Collins Cemetery Site (054-5024) has been recorded in the eastern portion of the North Anna property. The cemetery includes a dry-laid stone wall and nine marked graves associated with the late 19th century Beech Hill home of John Lewis Collins. The National Register of Historic Places (NRHP) status of the site has not been determined.
- A second cemetery (44LS0221) is located in the western portion of the property and includes 12 possible human interments. The NRHP status was classified as potentially eligible by the Virginia SHPO.
- A third cemetery (44LS0227) is also located in the western portion of the property. The cemetery includes 30 possible human interments, enclosed by a tall chain link fence. The NRHP status was classified as not evaluated by the Virginia SHPO.
- A fourth cemetery (44LS0222) is also located in the western portion of the North Anna property. This cemetery includes seven possible interments and is surrounded by a tall chain link fence. The NRHP status was classified as potentially eligible by the Virginia SHPO.
- A single dwelling (44LS0226) is located in the western portion of the North Anna property and includes the remains of several stone walls and a chimney, as well as an artifact scatter. The NRHP status was classified as not evaluated by the Virginia SHPO.

No other archaeological sites have been recorded, but the entire site has not been subjected to archaeological survey. Constructing North Anna likely disturbed any historic and cultural material that may have been located within the nuclear power plant footprint. However, much of the surrounding area remains largely undisturbed (VEPCO 2020-TN8099).

An archaeological sensitivity analysis of Dominion's North Anna property was completed in 2001. Its purpose was to identify portions of the property with the potential to yield archaeological material. The analysis was based on previous archaeological investigations, a review of archival and secondary historical sources, topography, and a walkover of the property. The property was divided into three zones based on the potential for cultural resources and recommendations for ground disturbance within those areas. The three zones are (1) no potential (disturbed land), (2) low potential (near disturbed locations with greater than 15 percent slope), and (3) moderate-to-high potential (undisturbed and relatively flat land) (VEPCO 2020-TN8099).

Other historic properties located near North Anna include prehistoric- and historic-era archaeological sites, historic districts, and buildings, as well as sites, structures, and objects that may be considered eligible for listing in the National Register of Historic Places (NRHP). Historic and cultural resources also include traditional cultural properties that are important to a living community of people for maintaining their culture. “Historic property” is the legal term for a historic or cultural resource that is included in, or eligible for inclusion in, the NRHP. There are three historic properties within a 6-mi (10-km) radius of the North Anna site that are listed in the NRHP: (1) the Jerdone Castle, (2) the Harris-Poindexter House and Store, and (3) Andrews Tavern (VEPCO 2020-TN8099).

3.9.3 Procedures and Integrated Cultural Resources Management Plan

Cultural resources on the North Anna site are managed and protected by Dominion’s historic resources consultation guidance and cultural resources description process, which is specifically applicable to Dominion’s North Anna Power Station and Surry Power Station. The guidance document and the cultural resources description process ensure that cultural resources are protected from unauthorized disturbance and removal. The guidance protects both known and undiscovered cultural resources by establishing a step-by-step process for all activities that require a Federal permit, use Federal funding, or have the potential to impact cultural resources (VEPCO 2020-TN8099).

3.9.4 Proposed Action

The following sections address the site-specific environmental impacts of North Anna SLR on the environmental issues identified in Table 3-1 that relate to historic and cultural resources.

3.9.4.1 Historic and Cultural Resources

The NHPA, as amended (54 U.S.C. 300101 et seq.; TN4157), requires Federal agencies to consider the effects of their undertakings on historic properties. Issuing a renewed operating license to a nuclear power plant is an undertaking that could potentially affect historic properties. Historic properties are defined as resources included in, or eligible for inclusion in, the NRHP. The criteria for eligibility are listed in Title 36, “Parks, Forests, and Public Property” (36 CFR), Section 60.4, “Criteria for Evaluation,” and include (1) association with significant events in history, (2) association with the lives of persons significant in the past, (3) embodiment of distinctive characteristics of type, period, or construction, and (4) sites or places that have yielded, or are likely to yield, important information (TN1682).

The historic preservation review process (NHPA Section 106 TN4157) is outlined in regulations issued by the Advisory Council on Historic Preservation (ACHP) in 36 CFR Part 800, “Protection of Historic Properties.” The NRC complies with the obligations required under NHPA Section 106 through its process under NEPA (42 U.S.C. 4321 et seq.; TN661) In accordance with NHPA provisions, the NRC is required to make a reasonable effort to identify historic properties included, or eligible for inclusion, in the NRHP in the area of potential effect (APE). The APE for a license renewal action includes the nuclear power plant site, the transmission lines up to the first substation, and immediate environs that may be affected by the license renewal decision and land-disturbing activities associated with continued reactor operations during the license renewal term. Accordingly, the APE for North Anna SLR includes the 1,800-ac (730-ha) North Anna site that may be affected by maintenance and operations activities associated with continued reactor operations during the SLR term. The APE may also extend beyond North Anna property (i.e., Dominion’s property at North Anna) if maintenance and operations activities affect offsite historic properties. This is irrespective of land ownership or control.

If there are no historic properties within the APE or the undertaking (license renewal) would have no effect on historic properties, the NRC provides documentation of this finding to SHPO. In Virginia, the SHPO is within the Virginia Department of Historic Resources (DHR), which is responsible for administering Federal- and State-mandated historic preservation programs to identify, evaluate, register, and protect Virginia's archaeological and historical resources. The NRC also notifies all consulting parties, including Indian Tribes, and makes this finding public (through the NEPA process) before issuing the renewed operating license. Similarly, if historic properties are present and could be affected by the undertaking, the NRC is required to assess and resolve any adverse effects in consultation with the SHPO and any Indian Tribe that attaches religious and cultural significance to identified historic properties.

3.9.4.2 Consultation

In accordance with 36 CFR 800.8(c), "Coordination with the National Environmental Policy Act," on October 30, 2020, the NRC staff initiated written consultations with the Advisory Council on Historic Preservation and the Virginia SHPO (see Appendix C, Section C.3).

Also, on October 30, 2020, the NRC staff initiated consultation with the following federally recognized Tribes (see Appendix C, Section C.3, "National Historic Preservation Act Section 106 Consultation"):

- Absentee-Shawnee Tribe
- Catawba Indian Nation
- Cherokee Nation
- Chickahominy Indian Tribe
- Chickahominy Indians—Eastern Division
- Delaware Nation
- Delaware Tribe of Indians
- Eastern Band of Cherokee Indians
- Eastern Shawnee Tribe of Oklahoma
- Monacan Indian Nation
- Nansemond Indian Nation
- Pamunkey Indian Tribe
- Rappahannock Tribe
- Shawnee Tribe
- Tuscarora Nation of New York
- United Keetoowah Band of Cherokee Indians in Oklahoma
- Upper Mattaponi Indian Tribe

In these letters, the NRC staff provided information about the proposed action, defined the APE, and indicated that the NRC would comply with Section 106 of the NHPA through the NEPA process, in accordance with 36 CFR 800.8(c) TN513. The NRC staff invited participation in the identification and possible decisions concerning historic properties and invited participation in the scoping process. Separate from these consultations, the NRC staff also sent letters inviting the following State-recognized Tribes to participate in the scoping process: the Cheroenhaka (Nottoway) Tribe, the Mattaponi Tribe, the Meherrin Nation, the Nottoway Tribe, and the Patawomeck Tribe.

The NRC staff received responses from three federally recognized Tribes with which the staff had initiated consultation. The response from the Pamunkey Indian Tribe expressed several concerns, including “potential environmental impacts from the renewal of the operating license;” NRC’s “ability to conduct a National Environmental Policy Act (NEPA) review which will address potential cumulative effects”; and the effectiveness of “conducting an environmental review so early in the life cycle of the current license…” Accordingly, they asked to review associated documents and indicated that they “would like to consult further with [NRC] on this matter to address why the license renewal is being reviewed so early.” In response, the NRC staff opened a dialog with the Pamunkey Indian Tribe and invited them to attend the North Anna SLR environmental site audit discussions regarding historic and cultural resources.

Other responses were received from the Delaware Tribe, which indicated that it “has no historic interest in this region of Virginia and therefore has no objection to the project,” and the Cherokee Nation, which stated that North Anna are located “outside the Cherokee Nation’s Area of Interest,” and that they defer to “federally recognized Tribes that have an interest in this land base at this time.”

3.9.4.3 Findings

As described in Section 3.8.2, there are five identified historic resources on the North Anna property. Dominion has administrative procedures and a site-specific cultural resource management plan in place to manage and protect cultural resources at North Anna. There are no planned physical changes or ground-disturbing activities at North Anna to support license renewal (VEPCO 2020-TN8099). In 2019, the Virginia DHR responded to a notice of Dominion’s intention to pursue renewal of North Anna operating licenses, stating they “concur that the continued operation of the facility would not adversely affect historic properties.” In that letter, the Virginia DHR also asked that Dominion consult on all projects involving ground-disturbing activities at North Anna in areas not previously disturbed, and ensure that contact information remains valid in any updates to disturbing activities at North Anna in areas not previously disturbed, and ensure that contact information remains valid in any updates to associated planning documents (VEPCO 2020-TN8099).

In 2020, the Virginia DHR requested that Dominion also complete an architectural survey of the North Anna facility and assess its eligibility for the NRHP (VEPCO 2020-TN8099). An architectural survey commissioned by Dominion in 2020 recommended that North Anna buildings are not eligible for listing in the National Register of Historic Places. The Virginia DHR concurred with this assessment and determined that no historic properties will be affected by the continued operation of the facility (VEPCO 2021-TN8180).

Based on the location of historic properties within and near the APE, Tribal input, Dominion’s administrative procedures and site-specific cultural resource management plan, and the absence of any planned physical changes or ground-disturbing activities, the NRC staff concludes that the proposed action (SLR) would not adversely affect historic properties (36 CFR 800.4(d)(1)-TN513).

3.9.5 No-Action Alternative

Known historic properties and cultural resources at North Anna would be unaffected if the NRC does not renew the operating license and Dominion terminates reactor operations. As stated in the decommissioning LR GEIS (NUREG-0586, Supplement 1), the NRC concluded that impacts on cultural resources would be SMALL at nuclear power plants where decommissioning activities would only occur within existing industrial site boundaries. Impacts cannot be predicted generically if decommissioning activities would occur outside of the previously disturbed industrial site boundaries, because impacts depend on site-specific conditions. In these instances, impacts could only be determined through site-specific analysis (NRC 2002-TN7254).

In addition, 10 CFR 50.82, “Termination of License,” requires power reactor licensees to submit a post-shutdown decommissioning activities report to the NRC (TN249). The post-shutdown decommissioning activities report describes planned decommissioning activities at the nuclear power plant. Until the post-shutdown decommissioning activities report is submitted, the NRC staff cannot determine whether historic properties would be affected outside the existing industrial site boundary after the nuclear power plant ceases operations.

3.9.6 Replacement Power Alternatives: Common Impacts

If construction and operation of replacement power alternatives require a Federal license or permit (i.e., Federal undertaking), a Federal agency would need to make a reasonable effort to identify historic properties within the APE. The agency would then need to consider the effects of the undertaking on historic properties in accordance with NHPA Section 106. Identified historic and cultural resources would need to be recorded and evaluated for eligibility for listing in the NRHP. If it is determined that historic properties are present and could be affected by the undertaking, any adverse effects would need to be assessed and mitigated in consultation with the Virginia SHPO and any affected Indian Tribe through the Section 106 process.

Construction

The potential impact on historic properties and other cultural resources during the construction of replacement power facilities would vary depending on the degree of ground disturbance.

Undisturbed land areas would need to be surveyed to identify and record historic and cultural material. Any historic and cultural resources and archaeological sites found during these surveys would need to be evaluated for eligibility for listing in the NRHP. Areas of greatest cultural sensitivity should be avoided while maximizing the use of previously disturbed areas.

Operation

Historic properties and cultural resources could be affected by ground-disturbing maintenance activities when operating the replacement power plant. As in the case of construction (discussed above), undisturbed land areas would need to be surveyed to identify and record historic and cultural material. Any historic and cultural resources and archaeological sites found during these surveys would need to be evaluated for eligibility for listing in the NRHP. Areas of greatest cultural sensitivity should be avoided while maximizing the use of previously disturbed areas.

3.9.7 New Nuclear (Small Modular Reactor) Alternative

Potential impacts on historic properties and other cultural resources during construction and operation of a new SMR unit would include those common to all replacement power alternatives. The extent of potential impacts on historic properties would depend on the degree to which the land chosen for the new nuclear facility has been previously developed or disturbed. Some structures, such as the power block, may be visible offsite. Avoidance of historic and cultural material may not be possible but could be managed. The impact determination of this alternative would depend on the specific location of the new facility. The Virginia DHR would need to be consulted before commencing any ground-disturbing activities in undisturbed land areas at North Anna.

3.9.8 Combination Alternative (Solar, Offshore Wind, Small Modular Reactor, and Demand-Side Management)

Potential impacts on historic properties and other cultural resources during construction and operation of a combination of solar photovoltaic, offshore wind, and new nuclear power generating facilities would include those common to all replacement power alternatives. Some infrastructure upgrades could be required. The extent of impact on historic properties would depend on the area chosen for these new facilities. Taller structures such as wind turbines would be visible for extended distances.

Avoidance of historic and cultural material may not be possible but could be managed. Activities associated with demand-side management would not likely have any direct impact on historic properties and other cultural resources. The impact determination of this alternative would depend on the specific location of new facilities. The Virginia DHR would need to be consulted before commencing any ground- or seabed-disturbing activities in undisturbed areas at North Anna and at other onshore and offshore locations within its jurisdiction.

3.10 Socioeconomics

This section describes current socioeconomic factors that have the potential to be affected by changes in nuclear power plant operations at North Anna Units 1 and 2. North Anna and the communities that support it can be described as a dynamic socioeconomic system. The communities supply the people, goods, and services required to operate the nuclear power plant. Power plant operations, in turn, supply wages and benefits for people and dollar expenditures for goods and services. The measure of a community's ability to support North Anna nuclear power plant operations depends on its ability to respond to changing environmental, social, economic, and demographic conditions.

3.10.1 Nuclear Power Plant Employment

The socioeconomic ROI is defined by the areas where North Anna workers and their families reside, spend their income, and use their benefits, thus affecting the economic conditions of the region. Dominion employs a permanent workforce of approximately 900 workers, including approximately 175 supplemental employees (VEPCO 2020-TN8099). Approximately 80 percent of North Anna workers reside in one independent city and five counties in Virginia (see Table 3-21). The remaining workers are spread among other counties in Virginia and other states. Because most North Anna workers are concentrated in Louisa and Orange counties, the greatest socioeconomic effects are likely to be experienced there. The focus of the impact analysis, therefore, is on the socioeconomic impacts of continued North Anna operations on these two counties.

Refueling outages occur on an 18-month staggered cycle for Units 1 and 2 and historically have lasted approximately 32 days per unit. During refueling outages, an additional 500 to 1,000 workers (VEPCO 2020-TN8099) are onsite.

Table 3-21 Residence of Dominion Employee by Virginia County or City

County or City[a]	Number of Employees	Percentage of Total
Total	903	100.0
Fredericksburg[a]	65	7.2
Hanover	82	9.1
Henrico	79	8.7
Louisa	325	36.0
Orange	104	11.5
Spotsylvania	69	7.6
Other counties and cities	179	19.8

(a) Virginia independent cities.
Source: VEPCO 2020-TN8099.

3.10.2 Regional Economic Characteristics

Goods and services are needed to operate North Anna Units 1 and 2. Although procured from a wider region, some portion of these goods and services are purchased directly from within the socioeconomic ROI. These transactions sustain existing jobs and maintain income levels in the local economy. This section presents information on employment and income in the North Anna socioeconomic ROI.

3.10.2.1 Regional Employment and Income

According to the U.S. Census Bureau's (USCB) 2017–2021 American Community Survey 5-Year Estimates, the educational, health, and social services industry represented the largest employment sector in the socioeconomic ROI, followed by retail (USCB 2022-TN9556).

Estimated income information for the socioeconomic ROI (USCB 2022-TN9556) is presented in Table 3-22.

Table 3-22 Estimated Income Information for the North Anna Socioeconomic Region of Influence (2017–2021, 5-Year Estimates)

Metric	Louisa County	Orange County	Virginia
Median household income (dollars)[a]	70,974	79,211	80,615
Per capita income (dollars)[a]	38,360	36,839	43,267
Families living below the poverty level (percent)	6.8	8.7	6.8
People living below the poverty level (percent)	10.8	11.3	9.9

(a) In 2021 inflation-adjusted dollars
Source: USCB 2022-TN9556

3.10.2.2 Unemployment

According to the Census Bureau's 2017–2021 American Community Survey 5-Year Estimates, the unemployment rates in Louisa County and Orange County were 5.4 and 3.7 percent, respectively. Comparatively, the unemployment rate in Virginia during this same time period was 2.9 percent (USCB 2022-TN9556).

3.10.3 Demographic Characteristics

An estimated 2,282,485 people live within 50 mi (80 km) of North Anna. Table 3-23 shows population projections and percent growth from 1980 to 2060 in the two-county North Anna

ROI. Over the last several decades, Louisa and Orange counties have experienced increasing populations. Based on this information, the populations of Louisa County and Orange County are projected to continue to increase at a moderate rate.

Table 3-23 Population and Percent Growth in North Anna Socioeconomic Region of Influence Counties 1980–2020 and 2030–2060 (Projected)

Data Type	Year	Louisa County Population	Louisa County Percent Change	Orange County Population	Orange County Percent Change
Recorded	1980	17,825	–	18,063	–
Recorded	1990	20,325	14.0	21,421	18.6
Recorded	2000	25,627	26.1	25,881	20.8
Recorded	2010	33,153	29.4	33,481	29.4
Recorded	2020	37,596	11.6	36,254	8.3
Estimated Projected	2030	41,436	10.2	38,468	6.1
Estimated Projected	2040	46,722	12.8	43,010	11.8
Estimated Projected	2050	52,706	12.8	48,197	12.1
Estimated Projected	2060	59,456	12.8	54,010	12.1

– = data not available.
Sources: Decennial population data for 1980–2020 (USCB 2023-TN8538); projections for 2030–2050 by University of Virginia, WCCPS (2023-TN8539); 2060 calculated.

The 2020 Census demographic profile of the two-county ROI population is presented in Table 3-24. According to the 2020 Census, minorities (race and ethnicity combined) comprised approximately 24 percent of the total two-county population (USCB 2023-TN8538). The largest minority populations in the ROI were Black or African American (approximately 14 percent), followed by individuals of two or more races (approximately 4.5 percent), and Hispanic, Latino, or Spanish origin of any race (approximately 3.5 percent).

Table 3-24 Demographic Profile of the Population in the North Anna Region of Influence in 2020

Demographic	Louisa County	Orange County	Region of Influence
Total population	37,596	36,254	73,850
Percent White race	75.9	75.5	75.9
Percent Black or African American race	14.3	11.9	14.3
Percent American Indian and Alaska Native race	0.2	0.3	0.2
Percent Asian race	0.7	0.9	0.7
Percent Native Hawaiian and other Pacific Islander race	0.0	0.0	0.0
Percent some other race	0.4	0.4	0.4
Percent two or more races	4.8	5.0	4.9
Hispanic, Latino, or Spanish ethnicity of any race (total population)	1,365	2,171	3,536
Percent Hispanic, Latino, or Spanish ethnicity of any race (total population)	3.6	6.0	3.6
Total minority	9,061	8,865	17,926
Percent of total population	24.1	24.5	24.1

Source: USCB 2023-TN8538.

3.10.3.1 Transient Population

Within 50 mi (80 km) of North Anna, recreational opportunities attract daily and seasonal visitors who create a demand for temporary housing and services. Based on the Census Bureau's 2017–2021 American Community Survey 5-Year Estimates (USCB 2022-TN9556), approximately 19,000 seasonal housing units are located within 50 mi (80 km) of North Anna. Of those, 2,333 housing units are in the two-county socioeconomic ROI.

3.10.3.2 Migrant Farm Workers

Migrant farm workers are individuals whose employment requires travel to harvest agricultural crops. These workers may or may not have a permanent residence. Some migrant workers follow the harvesting of crops, particularly fruit, throughout rural areas of the United States. Migrant workers may be members of minority or low-income populations. Because they travel and can spend a significant amount of time in an area without being actual residents, migrant workers may be unavailable for counting by census takers. If uncounted, these minority and low-income workers would be under-represented in the decennial census population counts.

Beginning with the 2002 Census of Agriculture, farm operators were asked whether they hired migrant workers—defined as a farm worker whose employment required travel—to do work that prevented the workers from returning to their permanent place of residence the same day. The U.S. Department of Agriculture's National Agricultural Statistics Survey conducts the Census of Agriculture every 5 years. This results in a comprehensive compilation of agricultural production data for every county in the United States.

Information about both migrant and temporary farm labor (i.e., working less than 150 days) can be found in the 2017 Census of Agriculture. Table 3-25 presents information on migrant and temporary farm labor within 50 mi (80 km) of North Anna.

According to the 2017 Census of Agriculture, approximately 7,500 farm workers were hired to work for less than 150 days and were employed on 2,388 farms within 50 mi (80 km) of North Anna. The county with the highest number of temporary farm workers (1,350 workers on 421 farms) was Rockingham County, Virginia (USDA 2017-TN8540). Approximately 108 farms, in the 50-mi (80-km) radius of North Anna, reported hiring approximately 740 migrant workers in the 2017 Census of Agriculture. Fauquier County, Virginia, had the highest number of farms (17) reporting migrant farm labor (USDA 2017-TN8540).

Table 3-25 Migrant Farm Workers and Temporary Farm Labor in Counties Located Within 50 mi (80 km) of North Anna

State	County[(a)]	Number of Farms with Hired Farm Labor[(b)]	Number of Farms Hiring Workers for Less Than 150 Days[(b)]	Number of Farm Workers Working for Less Than 150 Days[(b)]	Number of Farms Reporting Migrant Farm Labor[(b)]
All	Total	3,499	2,388	7,464	108
Maryland	Charles	67	56	[(c)]	2
Virginia	Albemarle	288	157	674	6
Virginia	Amelia	88	74	185	4
Virginia	Buckingham	85	62	182	3
Virginia	Caroline	42	29	130	9

Table 3-25 Migrant Farm Workers and Temporary Farm Labor in Counties Located Within 50 mi (80 km) of North Anna (Continued)

State	County[(a)]	Number of Farms with Hired Farm Labor[(b)]	Number of Farms Hiring Workers for Less Than 150 Days[(b)]	Number of Farm Workers Working for Less Than 150 Days[(b)]	Number of Farms Reporting Migrant Farm Labor[(b)]
Virginia	Chesterfield	27	25	111	1
Virginia	Culpepper	178	134	315	9
Virginia	Cumberland	51	37	110	1
Virginia	Essex	29	20	40	-
Virginia	Fairfax	41	35	426	-
Virginia	Fauquier	367	252	700	17
Virginia	Fluvanna	57	54	117	-
Virginia	Goochland	101	72	147	-
Virginia	Greene	47	30	60	2
Virginia	Hanover	161	116	402	5
Virginia	Henrico	18	13	54	2
Virginia	King and Queen	35	27	47	-
Virginia	King George	27	20	63	-
Virginia	King William	29	16	52	2
Virginia	***Louisa***	***102***	***73***	***198***	***6***
Virginia	Madison	152	99	177	3
Virginia	New Kent	20	18	40	-
Virginia	***Orange***	***154***	***98***	***484***	***6***
Virginia	Page	137	87	211	7
Virginia	Powhatan	67	54	154	2
Virginia	Prince William	90	63	175	4
Virginia	Rappahannock	129	99	242	4
Virginia	Richmond	31	17	(c)	-
Virginia	Rockingham	697	421	1,350	8
Virginia	Spotsylvania	86	69	300	-
Virginia	Stafford	23	13	26	-
Virginia	Westmoreland	73	48	292	5

(a) Counties within 50 mi (80 km) of North Anna with at least one block group located within the 50 mi (80 km) radius.
(b) Table 7. Hired Farm Labor—Workers and Payroll: 2017.
(c) Withheld to avoid disclosing data for individual farms.
Note: ROI counties are in bold italics.
Source: 2017 Census of Agriculture—County Data (USDA 2017-TN8540).

3.10.4 Housing and Community Services

This section presents information on housing and local public services, including education and water supply.

3.10.4.1 Housing

Table 3-26 lists the total number of occupied and vacant housing units, vacancy rates, and median values of housing units in the ROI. Based on the Census Bureau's 2017–2021 American Community Survey 5-year Estimates (USCB 2022-TN9556), there were approximately 32,900 housing units in the ROI, of which approximately 28,000 were occupied. The median values of owner-occupied housing units in the ROI range from $239,300 in Louisa County to $272,200 in Orange County. The homeowner vacancy rate is less than 1 percent for both counties (USCB 2022-TN9556).

Table 3-26 Housing in the North Anna Region of Influence (2017–2021, 5-Year Estimate)

Housing Characteristic	Louisa County	Orange County	Region of Influence
Total housing units	17,409	15,529	32,938
Occupied housing units	14,192	13,970	28,162
Total vacant housing units	3,217	1,559	4,776
Percent total vacant	18	10	14
Owner-occupied units	11,498	11,010	22,508
Median value (dollars)	239,300	272,200	255,750
Owner vacancy rate (percent)	0.7	0.8	0.8
Renter-occupied units	2,694	2,960	5,654
Median rent (dollars/month)	1,046	950	998
Rental vacancy rate (percent)	3.3	1.0	2.2

Source: USCB 2022-TN9556.

3.10.4.2 Education

The Louisa County Public School district comprises six public schools, with a total of 5,150 students in the 2021–2022 school year. These six schools include four elementary schools (grades pre-kindergarten through 5), one middle school (grades 6 through 8), and one high school (grades 9 through 12). The schools are in Mineral and Louisa, Virginia (USDA 2017-TN8540).

3.10.4.3 Public Water Supply

Major water sources for Louisa County and the towns of Louisa and Mineral include Lake Anna, groundwater wells, an irrigation lake on Spring Branch, and the Northeast Creek Reservoir. Approximately 25,590 people use private groundwater wells for residential water supply. Overall, Louisa County reported using 28.44 mgd in 2010, with water use demand projected to rise to 45.64 mgd by 2040. Of this total, the community water system used approximately 0.618 mgd, with use projected to rise to 1.918 mgd in 2040. Future water demands in the county may exceed the current supply by the year 2025. Louisa County partnered with Fluvanna County to create the James River Water Authority, which has a Virginia Water Protection Permit for withdrawal from the James River. North Anna is not connected to a municipal system and accesses potable water through a series of groundwater wells (VEPCO 2020-TN8099).

The Louisa County Water Authority has two public water facilities and two wastewater treatment facilities servicing residents and industry. The county and the town of Louisa share ownership of the regional sewage treatment plant, but each owns and operates its own collection system. The town of Mineral owns and operates its collection system. Additional public sewage treatment facilities in Louisa County include the Zion Crossroads Wastewater Treatment Plant and Laurel Hill Water and Sewer System. Less than 20 percent of the county's present population is serviced by public or private wastewater treatment facilities. Most residents and businesses in Louisa County are served by septic tanks and sanitary drainage fields.

In Orange County (population 33,481 in 2010) and the towns of Gordonsville and Orange, the major water sources include the Rapidan River, purchased water, and groundwater wells. Approximately 17,280 people use private groundwater wells for residential water supply. Overall, Orange County reported using 1.84 mgd in 2010, with water use demand projected to rise to 4.47 mgd by 2040. Of this total, the community water system used 1.363 mgd in 2010, with use projected to rise to 3.697 mgd in 2040. Possible alternatives to address future water demand, include increasing the existing, permitted surface water withdrawal, developing new raw water storage, and developing new groundwater supplies (VEPCO 2020-TN8099).

While population and water demand are projected to increase during the SLR term, existing water sources are expected to meet the increasing needs of the population. Louisa and Orange counties have enough water service capabilities to meet the needs of the public (VEPCO 2020-TN8099).

3.10.5 Tax Revenues

Dominion pays annual property taxes to both Louisa County and Spotsylvania County, based on the assessed value of North Anna. Between 2015 and 2021, Dominion Virginia, LLC property tax payments to Louisa County varied between approximately $10.2 and 13.0 million (Table 3-27). Total property tax revenues for Louisa County were approximately $52.2 to $65.8 million. As seen in Table 3-27, Dominion's property tax payments to Louisa County represented roughly 15 to 25 percent of the county's property tax revenues.

Louisa County's total revenues from the general fund were $91 million for fiscal year 2021. The largest program receiving county funding was education, with over 50 percent in payments to the school system. This was followed by 11 percent for public safety and capital projects, and 8 percent for health and welfare services. The remainder was expended across a variety of programs, including judicial administration; public works; parks, recreation, and cultural programs.

Dominion also pays annual property taxes to Spotsylvania County on behalf of North Anna and other Dominion property located in the county (assessed value $167 million). Dominion's property tax payments to Spotsylvania County in Table 3-27 are based on the assessed valuation for North Anna alone and do not include the total property tax payment for Dominion property in Spotsylvania County. Dominion's property tax payment to Spotsylvania County from 2015 to 2021 ranged from $53,756 to $56,612, representing less than half a percent of the total county property tax revenue.

Dominion's property tax payments have remained relatively stable with just a slight decline because of depreciation between 2015 and 2021, with no adjustments to payments caused by reassessments or other actions that could have resulted in notable increases or decreases. Dominion does not anticipate any future changes in tax laws, rates, assessed property value, or any other adjustments that could result in a notable future increase or decrease in property taxes or other payments to Louisa County or Spotsylvania County (VEPCO 2020-TN8099).

Dominion also provides pass-through funds (e.g., approximately $500,000 to $600,000) to the Commonwealth of Virginia for emergency response support (VEPCO 2020-TN8099).

Table 3-27 Dominion Energy Virginia Property Tax Payments, 2015–2021

County	Year	Dominion Energy Virginia Property Tax Payments (in millions of dollars)	Property Tax Revenues (in millions of dollars)	Percent of County Property Tax Revenue
Louisa	2015	13.0	52.2	25
Louisa	2016	12.5	55.0	23
Louisa	2017	12.6	58.4	22
Louisa	2018	11.9	60.5	20
Louisa	2019	11.5	60.9	19
Louisa	2020	10.3	63.6	16
Louisa	2021	10.2	65.8	15
Spotsylvania	2015	0.054	156.7	0.03
Spotsylvania	2016	0.052	161.7	0.03
Spotsylvania	2017	0.050	167.5	0.03
Spotsylvania	2018	0.052	172.3	0.03
Spotsylvania	2019	0.055	178.2	0.03
Spotsylvania	2020	0.057	186.1	0.03
Spotsylvania	2021	0.056	191.0	0.03

Source: VEPCO 2020-TN8099., VEPCO 2022-TN8270.

3.10.6 Local Transportation

The primary road network surrounding North Anna is shown in Figure 2-1. A major east coast highway, Interstate 95, which runs north to Maine, and south to Florida through Richmond, Virginia, and Interstate 64, which runs west to Missouri and east to Chesapeake, Virginia, traverse approximately 16 and 15 mi (26 and 24 km) east of North Anna. Virginia State Route (SR) 601 and SR 652 run parallel with the Lake Anna shoreline and pass about 2.2 mi (4 km) northeast and 1.5 mi (2 km) south of the nuclear power plant site, respectively. Virginia SR 208 crosses Lake Anna at a point about 2 mi (3 km) northwest of the site and joins U.S. Highway 522 about 5 mi (8 km) west-northwest of North Anna (VEPCO 2020-TN8099).

The primary access to North Anna is from Virginia SR 700 (Haley Drive), which provides access to the nuclear power plant site by a two-lane, predominantly southwest-northeast paved road. Virginia SR 652 (Kentucky Springs Road) is also a two-lane paved road and provides commuter traffic access to the North Anna site by SR 700 at an intersection located approximately 1.5 mi (2 km) southwest of the nuclear power plant site. Neither SR 700 nor SR 652 are primary arterials in the area. Over the years, the traffic volume counts taken on SR 652 and SR 700 have revealed little fluctuation in traffic flow. The most recent average annual daily traffic (AADT) count in September 2013 for SR 700 (Haley Drive) east of SR 652 was 3,600, and the 2017 AADT county for SR 700 (Johnson Road) west of SR 652 was 1,300. The 2017 AADT count on SR 652 (Kentucky Springs Road) south of SR 700 was 3,100; the AADT count was 3,900 north of SR 700 (VEPCO 2020-TN8099).

Table 3-28 lists the Virginia Department of Transportation AADT volumes for these State roads with nuclear power plant access. The AADT values represent traffic volumes for a 24-hour period factored by both day of week and month of year.

Table 3-28 Virginia State Routes in the Vicinity of North Anna—2017 Annual Average Daily Traffic Volume Estimates

Roadway and Location	Annual Average Daily Traffic Volume Estimates
SR 652 Kentucky Springs Road—South of SR 700, SR 1205 Ordinary Road to SR 700 Johnson Road	3,100
SR 652 Kentucky Springs Road—North of SR 700, SR 700 Johnson Road to SR 790 Michell Point Road	3,900
SR 700 Johnson Road—West of SR 652, SR 618 Fredericks Hall Road to SR 652 Kentucky Springs Road	1,300
SR 700 Johnson Road—East of SR 652, SR 652 Kentucky Springs Road to Dead End (North Anna Power Station entrance)	3,600[a]

(a) Count as of September 24, 2013.
Source: VEPCO 2020-TN8099.

3.10.7 Proposed Action

The following sections address the site-specific socioeconomic impacts of the proposed action, renewing the North Anna operating licenses, for the issues identified in Table 3-1.

3.10.7.1 Employment and Income, Recreation, and Tourism

Socioeconomic effects of ongoing reactor operations at North Anna have become well established as regional socioeconomic conditions have adjusted to the presence of the nuclear power plant. Dominion indicated in its ER that it has no plans to increase or decrease its workforce, will not conduct refurbishment activities, and does not anticipate changes to North Anna during the SLR term (VEPCO 2020-TN8099). Consequently, people living near North Anna would not experience any changes in employment, income, recreation, and tourism during the SLR term beyond what is currently being experienced. Employment, income, recreational, and tourism are not expected to change. Based on this information, the NRC staff concludes that employment, income, recreational, and tourism impacts during the North Anna SLR term would be SMALL.

3.10.7.2 Tax Revenues

Since commencement of reactor operations, North Anna has become a well-established source of property and sales tax revenue in local communities. Dominion indicated in its ER that it has no plans to conduct refurbishment activities during the SLR term, affecting the value of North Anna (VEPCO 2020-TN8099). Therefore, tax payments during the SLR term would be similar to those already being paid. Based on these considerations, the NRC staff concludes that tax revenue impacts during the SLR term would be SMALL.

3.10.7.3 Community Services and Education

Tax payments paid by Dominion help support public services. Dominion indicated in its ER that it has no plans to increase or decrease its workforce and will not conduct refurbishment activities affecting the value of North Anna (VEPCO 2020-TN8099) and property tax payments. Therefore, revenue from North Anna property tax payments used to support community services and education are not expected to change. Based on these considerations, the NRC staff concludes that impacts to community services and education during the SLR term would be SMALL

3.10.7.4 Population and Housing

Population changes affect housing availability and value. Dominion indicated in its ER that it has no plans to increase or decrease its workforce. Therefore, population and housing are not expected to change. Therefore, the NRC staff concludes that population and housing impacts during the SLR term would be SMALL.

3.10.7.5 Transportation

Commuting patterns attributable to North Anna are well established. Dominion indicated in its ER that it has no plans to increase or decrease its workforce and will not conduct refurbishment activities. Therefore, impacts to transportation are not expected to change. Based on these considerations, the NRC staff concludes that transportation impacts during the SLR term would be SMALL.

3.10.8 No-Action Alternative

3.10.8.1 Socioeconomics

Under the no-action alternative, the NRC would not renew the operating license, and North Anna Units 1 and 2 would shut down on or before the expiration of the current facility operating license. This would have a noticeable impact on socioeconomic conditions in the counties and communities near North Anna. The loss of jobs, income, and tax revenue would have an immediate socioeconomic impact. As jobs are eliminated, some, but not all, of the over 900 workers could leave. Income from the buying and selling of goods and services needed to maintain the nuclear power plant would also be reduced. In addition, loss of tax revenue could affect the availability of public services.

If workers and their families move away, increased vacancies and reduced demand for housing would likely cause property values to fall. The greatest socioeconomic impact would be experienced in the communities located nearest to North Anna, in Louisa and Spotsylvania counties. However, the loss of jobs, income, and tax revenue may not be as noticeable in larger communities, due to the time and steps required to prepare the nuclear power plant for decommissioning. Therefore, depending on the jurisdiction, the NRC staff concludes that the socioeconomic impacts from not renewing the operating license and terminating reactor operations at North Anna could range from SMALL to MODERATE.

3.10.8.2 Transportation

Traffic volume on roads near North Anna may be noticeably reduced after the termination of reactor operations. Any reduction in traffic volume would coincide with workforce reductions at North Anna. The number of truck deliveries and shipments would also be reduced until active decommissioning. Therefore, the NRC staff concludes that due to the time and steps required to prepare the nuclear power plant for decommissioning, traffic-related transportation impacts would be SMALL.

3.10.9 Replacement Power Alternatives: Common Impacts

Workforce requirements for replacement power alternatives were evaluated to measure their possible effects on current socioeconomic and transportation conditions. Table 3-29 summarizes the NRC staff's conclusions related to socioeconomic and transportation impacts of reasonable replacement power alternatives. The following sections provides a discussion of the common socioeconomic and transportation impacts during construction and operation of replacement power-generating facilities.

Table 3-29 Socioeconomic and Transportation Impacts of Replacement Power Alternatives

Alternative	Resource Requirements	Impacts	Discussion
New Nuclear (small modular reactors)	Construction: peak 2,600 workers for several months	MODERATE to LARGE	If all five small modular reactors are constructed/installed at the same time. Some nuclear workers could transfer from North Anna.
New Nuclear (small modular reactors)	Operations: 1,200 workers	MODERATE to LARGE	If all five small modular reactors are constructed/installed at the same time. Some nuclear workers could transfer from North Anna.
Combination, Solar, Offshore Wind, Small Modular Reactor, and Demand-Side Management	Construction: peak 2,200 (Solar), 300 (Wind), and 600 (Nuclear) workers for several months	MODERATE to LARGE	The demand-side management component could generate additional employment, depending on the nature of the conservation and energy efficiency programs and the need for direct measure installations in homes and office buildings. Jobs would likely be few and scattered throughout the region and would not have a noticeable effect on the local economy. The demand-side management component would not cause an increase in traffic volumes on local roads and would therefore have no transportation impacts.
Combination, Solar, Offshore Wind, Small Modular Reactor, and Demand-Side Management	Operations: 100 (Solar), 140 (Wind), and 250 (Nuclear) workers	MODERATE	The demand-side management component could generate additional employment, depending on the nature of the conservation and energy efficiency programs and the need for direct measure installations in homes and office buildings. Jobs would likely be few and scattered throughout the region and would not have a noticeable effect on the local economy. The demand-side management component would not cause an increase in traffic volumes on local roads and would therefore have no transportation impacts.

Source: AWEA 2020-TN8355, BLM 2019-TN8386; DOE 2011-TN8387, NRC 2018-TN7244.

3.10.9.1 Socioeconomics

Socioeconomic impacts are defined in terms of changes in the social and economic conditions of a region. For example, the creation of jobs and the purchase of goods and services during the construction and operation of a replacement power plant could affect regional employment, income, and tax revenue. For each alternative, two types of jobs would be created: (1) construction jobs, which are transient, short in duration, and less likely to have a long-term socioeconomic impact, and (2) operations jobs, which have the greater potential for permanent, long-term socioeconomic impacts.

While the selection of a replacement power alternative could create opportunities for employment and income and generate tax revenue in the local economy, employment, income, and tax revenue could be greatly reduced or eliminated in communities near North Anna. These impacts are described in the “No-Action Alternative” (Section 3.10.8).

Construction

The relative economic effect of an influx of workers on the local economy and tax base would vary and depend on the size of the workforce and construction phase. The greatest impact would occur in the communities where the majority of construction workers would reside and spend their income. As a result, some local communities could experience a short-term economic boom during construction from increased tax revenue, income generated by expenditures for goods and services, and increased demand for temporary (rental) housing. After construction, local communities would likely experience a return to preconstruction economic conditions.

Operation

Before the commencement of startup and operations, local communities could see an influx of operations workers and their families resulting in an increased demand for permanent housing and public services. These communities would also experience the economic benefits from increased income and tax revenue generated by the purchase of goods and services needed to operate a new replacement power plant. Consequently, power plant operations would have a greater potential for effecting permanent, long-term socioeconomic impacts on the region.

3.10.9.2 Transportation

Transportation impacts are defined in terms of changes in level of service conditions on local roads. Additional vehicles during construction and operations could lead to traffic congestion and level of service impacts on local roadways and delays at intersections.

Construction

Transportation impacts would consist of commuting workers and truck deliveries of equipment and material to the construction site. Traffic volumes would increase substantially during shift changes. Trucks would deliver equipment and material to the construction site and remove waste material, thereby increasing the amount of traffic on local roads. The increase in traffic volumes could result in level of service impacts and delays at intersections during certain hours of the day. In some instances, construction material could also be delivered and removed by rail or barge.

Operation

Traffic volumes would be greatly reduced after construction because of the smaller size of the operations workforce. Transportation impacts would consist of commuting operations workers and truck deliveries of equipment and material and removal of waste material.

3.11 Human Health

North Anna is both an industrial facility and a nuclear power plant. Similar to any industrial facility or nuclear power plant, the operation of North Anna over the SLR period will produce various human health risks for workers and members of the public. This section describes the human health risks resulting from the operation of North Anna, including from radiological exposure, chemical hazards, microbiological hazards, electromagnetic fields, and other hazards. The description of these risks is followed by the staff's analysis of the potential impacts on human health from the proposed action (SLR) and alternatives to the proposed action.

3.11.1 Radiological Exposure and Risk

Operation of a nuclear power plant involves the use of nuclear fuel to generate electricity. Through the fission process, the nuclear reactor splits uranium atoms, resulting generally in (1) production of heat that is then used to produce steam to drive turbines and generate electricity and (2) the creation of radioactive byproducts. As required by NRC regulations at 10 CFR 20.1101 (TN283), "Radiation Protection Programs," Dominion designed a radiation protection program to protect onsite personnel (including employees and contractor employees), visitors, and offsite members of the public from radiation and radioactive material at North Anna. The North Anna radiation protection program is extensive and includes, but is not limited to, the following:

- organization and administration (e.g., a radiation protection manager who is responsible for the program and who ensures there are trained and qualified workers for the program)
- implementing procedures
- ALARA Program to minimize dose to workers and members of the public
- dosimetry program (i.e., measure radiation dose of nuclear power plant workers)
- radiological controls (e.g., protective clothing, shielding, filters, respiratory equipment, and individual work permits with specific radiological requirements)
- radiation area entry and exit controls (e.g., locked or barricaded doors, interlocks, local and remote alarms, personnel contamination monitoring stations)
- posting of radiation hazards (i.e., signs and notices alerting nuclear power plant personnel of potential hazards)
- recordkeeping and reporting (e.g., documentation of worker dose and radiation survey data)
- radiation safety training (e.g., classroom training and use of mockups to simulate complex work assignments)
- radioactive effluent monitoring management (i.e., controlling and monitoring radioactive liquid and gaseous effluents released into the environment)
- radioactive environmental monitoring (e.g., sampling and analysis of environmental media, such as direct radiation, air, water, groundwater, milk, food products (corn, soybeans, and peanuts), fish, oysters, clams, crabs, silt, and shoreline sediment to measure the levels of radioactive material in the environment that may impact human health)
- radiological waste management (i.e., controlling, monitoring, processing, and disposing of radioactive solid waste)

For radiation exposure to North Anna personnel, the NRC staff reviewed the data contained in NUREG-0713, Volume 40, *Occupational Radiation Exposure at Commercial Nuclear Power Reactors and other Facilities 2018: Fifty-First Annual Report* (NRC 2020-TN7292). The 51st annual report was the most recent annual report available at the time of this environmental review. It summarizes the occupational exposure data in the NRC's Radiation Exposure Information and Reporting System database through 2018. These data are reported by nuclear power plant operators, as required by 10 CFR 20.2206 (TN283), “Reports of Individual Monitoring,” which requires them to report their occupational exposure data to the NRC annually.

NUREG-0713 calculates a 3-year average collective dose per reactor for workers at all nuclear power reactors licensed by the NRC. The 3-year average collective dose is one of the metrics that the NRC uses in the Reactor Oversight Program to evaluate the applicant’s ALARA program. Collective dose is the sum of the individual doses received by workers at a facility licensed to use radioactive material over a 1-year period. There are no NRC or EPA standards for collective dose. Based on the data for operating PWRs like the reactors at North Anna, the average annual collective dose per reactor-year was 37 person-rem. In comparison, North Anna had a reported annual collective dose per reactor-year of 48 person-rem.

In addition, as reported in NUREG-0713, for 2020, (NRC 2022-TN8530) no worker at North Anna received an annual dose greater than 1 rem (0.01 sievert [Sv]), which is much less than the NRC occupational dose limit of 5.0 rem (0.05 Sv) in 10 CFR 20.1201, “Occupational Dose Limits for Adults” (TN283).

Section 2.1.4, “Radioactive Waste Management Systems,” of this EIS discusses offsite dose to members of the public.

3.11.2 Chemical Hazards

State and Federal environmental agencies regulate the use, storage, and discharge of chemicals, biocides, and sanitary wastes. Such environmental agencies also regulate how facilities like North Anna manage minor chemical spills. Chemical and hazardous wastes can potentially impact workers, members of the public, and the environment.

Dominion currently controls the use, storage, and discharge of chemicals and sanitary wastes at North Anna in accordance with its chemical control procedures, waste management procedures, and North Anna site-specific chemical spill prevention plans. Dominion monitors and controls discharges of chemical and sanitary wastes through North Anna’s VPDES permit process, which is discussed in Section 3.5.1.3, “Surface Water Quality and Effluents,” of this report. These nuclear power plant procedures, plans, and processes are designed to prevent and minimize the potential for a chemical or hazardous waste release and, in the event of such a release, minimize impact on workers, members of the public, and the environment (VEPCO 2020-TN8099).

3.11.3 Microbiological Hazards

Thermal effluents associated with nuclear power plants that discharge to a cooling pond or lake, such as North Anna, have the potential to promote the growth of certain thermophilic microorganisms linked to adverse human health effects. Microorganisms of particular concern include several types of bacteria (*Legionella* species, *Salmonella* species, *Shigella* species, and *Pseudomonas aeruginosa*) and the free-living amoeba *Naegleria fowleri*.

The public can be exposed to the thermophilic microorganisms *Salmonella*, *Shigella*, *P*. *aeruginosa*, and *N*. *fowleri* during swimming, boating, or other recreational uses of freshwater. If these organisms are naturally occurring and a nuclear power plant’s thermal effluent enhances their growth, the public could experience an elevated risk of infection when recreating in the affected waters.

Nuclear power plant workers can be exposed to *Legionella* when performing cooling system maintenance through inhalation of cooling tower vapors because these vapors are often within the optimum temperature range for *Legionella* growth. Nuclear power plant personnel most likely to come in contact with aerosolized *Legionella* are workers who clean and maintain cooling towers and condenser tubes. Public exposure to *Legionella* from nuclear power plant operation is generally not a concern because exposure risk is confined to cooling towers and related components and equipment, which are typically within the protected area of the site and, therefore, are not accessible to the public.

<u>Thermophilic Microorganisms of Concern</u>

Salmonella typhimurium and *S. enteritidis* are two species of enteric bacteria that cause salmonellosis, a disease more common in summer than winter. Salmonellosis is transmitted through contact with contaminated human or animal feces and may be spread through water transmission, contact with infected animals or food, or contamination in laboratory settings (CDC 2022-TN8513). These bacteria grow at temperatures ranging from 77 to 113°F (25 to 45°C), have an optimal growth temperature around human body temperature (98.6°F [37°C]), and can survive extreme temperatures as low as 41°F (5°C) and as high as 122°F (50°C) (Oscar 2009-TN8514). Research studies examining the persistence of *Salmonella* species outside of a host found that the bacteria can survive for several months in water and in aquatic sediments (Moore et al. 2003-TN8515).

Shigella species causes the infection shigellosis, which can be contracted through contact with contaminated food, water, or feces. When ingested, the bacteria release toxins that irritate the intestines. Like salmonellosis, shigellosis infections are more common in summer than in winter because the bacteria optimally grow at temperatures between 77 and 99°F (25 and 37°C) (PHAC 2010-TN8868). Shigellosis outbreaks related to recreational uses of water are rare; almost all cases are related to food contamination.

Pseudomonas aeruginosa can be found in soil, hospital respirators, water, and sewage, and on the skin of healthy individuals. It is most commonly linked to infections transmitted in healthcare settings. Infections from exposure to *P. aeruginosa* in water can lead to the development of mild respiratory illnesses in healthy people. These bacteria optimally grow at 98.6°F (37°C) and can survive in high-temperature environments up to 107.6°F (42°C) (Todar 2004-TN7723).

The free-living amoeba *N. fowleri* prefers warm freshwater habitats and is the causative agent of human primary amebic meningoencephalitis (PAM). Infections occur when *N. fowleri* penetrate the nasal tissue through direct contact with water in warm lakes, rivers, or hot springs and migrate to the brain tissues. This free-swimming amoeba species grows best at higher temperatures of up to 115°F (46°C) (CDC 2021-TN7271). It typically is not present in waters below 95°F (35°C) (Tyndall et al. 1989-TN8598). The *N. fowleri*-caused disease PAM is rare in the United States. From 1962 through 2019, the CDC reports an average of 2.5 cases of PAM annually nationwide. Only seven cases have been reported from Virginia over that period (CDC 2021-TN7271).

Legionella is a genus of common warm water bacteria that occurs in lakes, ponds, and other surface waters, as well as some groundwater sources and soils. The bacteria thrive in aquatic environments as intracellular parasites of protozoa and are only pathogenic to humans when aerosolized and inhaled into the lungs. Approximately 2 to 5 percent of those exposed in this way develop an acute bacterial infection of the lungs known as Legionnaires' disease (AWT 2019-TN8518). Legionella optimally grows in stagnant surface waters containing biofilms or slimes that range in temperature from 95 to 113°F (35 to 45°C), although the bacteria can persist in waters from 68 to 122°F (20 to 50°C) (AWT 2019-TN8518). As such, human infection is often associated with complex water systems within buildings or structures, such as cooling towers (CDC 2016-TN8519). Potential adverse health effects related to *Legionella* would generally not be of concern at North Anna because the nuclear power plant does not use cooling towers. The CDC issues biannual surveillance summary reports concerning Legionnaires' disease. According to the most recently available data from these reports, no cases within Virginia were attributable to cooling systems, recreational uses of reservoirs or lakes, or other categories that could be attributable to nuclear power plant operation over the period 2014–2017 (CDC 2019-TN8520; CDC 2020-TN8521).

Baseline Conditions in Lake Anna

Lake Anna is typical of many shallow reservoirs in the southern and Mid-Atlantic region. It contains an upper eutrophic layer, a lower oligotrophic layer, and a mid-layer that is a blend of the two, and it remains hydrologically connected to the North Anna River via the North Anna Dam. Lake Anna contains appropriate ecological conditions to support thermophilic microorganisms; however, lake temperatures are generally below the optimum growth range for the microorganisms of concern, even within the area affected by the North Anna thermal discharge. In the summer months, surface water temperatures often range from the mid-80s°F to low 90s°F (approximately 29 to 34°C).

The thermal effluent from North Anna enters the WHTF before remixing with the lake. Within the WHTF, water moves through a series of three lagoons before it returns to Lake Anna at Dike 3. The VDEQ regulates discharge at Dike 3 as Outfall 001 in the North Anna VPDES permit. The VDEQ limits waste heat rejected to the lake at this location to 13.54×10^9 BTU per hour (VEPCO 2020-TN8383).

As part of its Lake Anna ecological monitoring, Dominion measures Lake Anna water temperatures in Lake Anna and the WHTF using fixed temperature recorders. Temperatures are reported by monitoring station as monthly maximum, mean, and minimum temperatures and compared with historical data. Within the WHTF, temperatures are recorded at three stations at a depth of 1 m (3.2 ft). The NRC staff reviewed data for the period 2015–2019. During this time, the maximum hourly temperature recorded in the WHTF at the end of the discharge canal (Station NADISC1, the closest station to where heated effluent returns to Lake Anna) has ranged from 101.12 to 105.26°F (38.4 to 40.7°C) (see Table 3-30) (VEPCO 2021-TN8268, 2020-TN8099). The NRC staff expects that maximum hourly temperatures during this period are representative of those that would be experienced during the proposed SLR term.

From 1975 through 1985, Dominion collected pre- and post-operational temperature data in Lake Anna in connection with a CWA Section 316(a) demonstration. As part of this effort, Dominion monitored water temperatures at seven Lake Anna stations. Researchers recorded temperatures hourly at most locations. The highest hourly average temperatures recorded in June, July, and August over this period were 91.8°F (33.2°C) (at an upper lake station in 1984), 92.7°F (33.7°C) (at an upper lake station in 1977), and 91.6°F (33.1°C) (at a lower lake station in 1980). The highest hourly average water temperature measured in an operational year was 92.3°F (33.5°C) in 1983 (VEPCO 2020-TN8099).

Table 3-30 Maximum Hourly Temperatures Recorded at Waste Heat Treatment Facility Station NADISC1, 2015–2019

Year	Maximum Hourly Temp. in °F (°C)
2015	101.1 (38.4)
2016	105.3 (40.7)
2017	103.8 (39.9)
2018	102.6 (39.2)
2019	105.3 (40.7)

Sources: VEPCO 2021-TN8268, VEPCO 2020-TN8099.

Thermophilic Microorganism Occurrence in Lake Anna

The free-living amoeba *N. fowleri* that causes the infection human PAM occurs within Lake Anna. *N. fowleri* was first identified in the lake in June 1978. In 1982, Dominion personnel worked with the State epidemiologist and relevant Federal and State agencies to determine whether the pathogen represented a public health risk. As a result of this coordination, the agencies determined that the risk to the public was too low to justify any action by Dominion or State agencies (VEPCO 2020-TN8099).

In 2007, researchers found *N. fowleri* at 9 of 16 test sites during summer lake sampling. However, total amoeba count, inclusive of *N. fowleri* and other amoeba species, was low (less than 12 amoebae per 50 mL) (Jamerson et al. 2009-TN9557, Marciano-Cabral 2007-TN9558).

In 2012, the VDH participated in a multistate environmental study of *N. fowleri* with the CDC. Of the samples collected at Lake Anna, no water samples tested positive for the amoeba (VEPCO 2020-TN8099). One sediment sample collected at the shore of the WHTF tested positive. Access to this area is restricted to adjacent private property owners (VEPCO 2020-TN8099).

The CDC, VDH, and Dominion report no occurrences of human infection caused by *N. fowleri* in Lake Anna since the amoeba was identified in the lake in 1978. Additionally, the NRC staff identified no records indicating increased concentrations or growth of *N. fowleri* in association with the North Anna thermal effluent.

During the most recent VPDES permit renewal process, VDH recommended that Dominion make WHTF temperature measurements publicly available to allow the public to make temperature-informed decisions about recreational use of Lake Anna, especially during warmer months. In response to the VDH recommendation, Dominion now posts WHTF lagoon temperatures online.[5] Dominion also maintains links to thermophilic microorganism health risk information on that web page.

The NRC staff identified no records of either increased growth of or human infection caused by any of the other thermophilic microorganisms of concern (i.e., *Salmonella typhimurium, S. enteritidis*, *Shigella* species, *Pseudomonas aeruginosa*, and *Legionella* species).

[5] https://www.dominionenergy.com/projects-and-facilities/nuclear-facilities/north-anna-power-station/waste-heat-treatment-facility

Virginia Department of Health Consultation

In August 2019, Dominion contacted VDH concerning the potential existence and perceived health risks that may be present in the portion of Lake Anna that receives the cooling water discharge from North Anna. In its response, the VDH mentioned no specific concerns relating to the microorganisms in question. In addition to addressing the thermophilic microorganisms of concern, the VDH described numerous reports of algal blooms in Lake Anna in 2019. It expressed concern that continued algae blooms could impact water quality at a downstream North Anna River drinking water intake used by Hanover County's Suburban Waterworks (VEPCO 2020-TN8099).

Dominion's subsequent response to the VDH explained that the harmful algal blooms referenced by VDH were located in an upper arm of Lake Anna many miles from Outfall 001 and outside the reaches of the North Anna thermal plume. The 2019 algal blooms were not associated with North Anna operations and did not affect the North Anna River (VEPCO 2020-TN8099). However, due to the VDH concerns and because algal blooms also have occurred in the WHTF, the NRC staff addresses this topic in more detail below.

Harmful Algal Blooms in Lake Anna

Cyanobacteria is a harmful alga that can cause skin rash and gastrointestinal illnesses. Since 2018, seasonal cyanobacteria blooms have been reported from several different areas of Lake Anna. The blooms typically appear between July and September when elevated temperatures, reduced water clarity, and elevated phosphorus and nitrogen concentrations combine to create favorable growth conditions. People can be exposed to the toxins from swimming in or drinking water that is affected by the algal bloom. The cyanobacteria that dominates fresh water algal blooms produces a liver toxin that can cause gastrointestinal illness as well as liver damage (NIEHS 2023-TN8522).

Beginning in 2018 when the issue first appeared, VDH initiated monitoring of lake conditions and cyanobacteria concentrations. When VDH deems concentrations to be at or above levels harmful to human health, it issues no-swim advisories for the affected areas through a press release on its website at: https://www.vdh.virginia.gov/news/.

Following VDH guidelines, Dominion also developed its own cyanobacteria sampling plan in 2018 for the WHTF. On its website, Dominion issues no-swim advisories for areas within the WHTF when harmful algal blooms are present.[6] Dominion lifted its last no-swim advisory on July 25, 2019, and has issued no advisories since then (Dominion 2023-TN8523).

Table 3-31 lists the areas of Lake Anna for which the VDH or Dominion have issued advisories since 2018. Before 2018, no blooms were reported from Lake Anna.

[6] https://www.dominionenergy.com/projects-and-facilities/nuclear-facilities/north-anna-power-station/waste-heat-treatment-facility

Table 3-31 Harmful Algal Bloom Advisories in Lake Anna, 2018–Present

Year	Affected Branches of Lake Anna
2018	Lower Pamunkey—Upper, Middle, and Lower North Anna—Upper, Middle, and Lower Fisherman's Cove Waste heat treatment facility (WHTF)—Beaver Creek, Elk Creek, Millpond Creek, and Moody Creek[(a)]
2019	Pamunkey—Upper, Middle, and Lower North Anna—Upper, Middle, and Lower Lake Anna State Park Beach Main Branch WHTF—Beaver Creek[(a)(b)]
2020	Pamunkey—Upper and Middle Terry's Run North Anna—Upper
2021	None to date

(a) Thermally affected by North Anna effluent discharges.
(b) Subsequent to Dominion issuing its swim advisory, Virginia Department of Health (VDH) revised its guidance for harmful algal bloom advisories. Under the revised criteria, the WHTF samples did not exceed the VDH threshold, and Dominion lifted the swim advisory (VEPCO 2021-TN8524).
Sources: VEPCO 2020-TN8099, VEPCO 2021-TN8524, VDH 2018-TN8525, VDH 2019-TN8526, VDH 2020-TN8527.

3.11.4 Electromagnetic Fields

Any electrical equipment will generate and EMF. All nuclear power plants have electrical equipment and power transmission systems associated with them. Power transmission systems consist of switching stations (or substations) located on the nuclear power plant site and the transmission lines needed to connect the plant to the regional electrical distribution grid. Transmission lines operate at a frequency of 60 Hz (60 cycles per second), which is low compared with the frequencies of 55 to 890 MHz for television transmitters and 1,000 MHz and greater for microwaves.

Electric fields are produced by voltage, and their strength increases with increases in voltage. A magnetic field is produced from the flow of current through wires or electrical devices, and its strength increases as the current increases. Electric and magnetic fields, collectively referred to as EMF, are produced by operating transmission lines.

Occupational workers or members of the public near transmission lines may be exposed to the EMFs produced by the transmission lines. The EMF strength varies in time as the current and voltage change, so the frequency of the EMF is the same (e.g., 60 Hz for standard alternating current). Electrical fields can be shielded by objects such as trees, buildings, and vehicles. Magnetic fields, however, penetrate most materials, but their strength decreases with increasing distance from the source.

The EMFs resulting from 60-Hz power transmission lines fall under the category of non-ionizing radiation. The LR GEIS (NRC 2013-TN2654) summarizes NRC accepted studies on the health effects of EMFs. There are no U.S. Federal standards limiting residential or occupational exposure to EMFs from power lines, but some States have set electric field and magnetic field standards for transmission lines (NIEHS 2002-TN6560). A voluntary occupational standard has been set for EMFs by the International Commission on Non-Ionizing Radiation Protection (ICNIRP 1998-TN6591). The National Institute of Occupational Safety and Health does not consider EMFs to be a proven health hazard (NIOSH 1996-TN6766).

3.11.5 Other Hazards

This section addresses two additional human health hazards: (1) physical occupational hazards and (2) occupational electric shock hazards.

Nuclear power plants are industrial facilities that have many of the typical occupational hazards found at any other electric power generation site. Nuclear power plant workers may perform electrical work, electric power line maintenance, repair work, and maintenance activities and may be exposed to potentially hazardous physical conditions (e.g., falls, excessive heat, cold, noise, electric shock, and pressure).

Under the Occupational Safety and Health Act of 1970, as amended (29 U.S.C. 651 et seq.; TN4453) is responsible for developing and enforcing workplace safety regulations. Occupational Safety and Health Administration (OSHA) is responsible for developing and enforcing workplace safety regulations. Congress created OSHA by enacting to safeguard the health of workers. With specific regard to nuclear power plants, plant conditions that result in an occupational risk, but do not affect the safety of licensed radioactive materials, are under the statutory authority of OSHA rather than the NRC, as set forth in a memorandum of understanding (NRC and OSHA 2013-TN8542) between the NRC and OSHA. Occupational hazards are reduced when workers adhere to safety standards and use appropriate protective equipment; however, fatalities and injuries from accidents may still occur. Dominion maintains an occupational safety program for its workers in accordance with OSHA regulations (VEPCO 2020-TN8099).

Based on its evaluation in the LR GEIS (NUREG-1437, NRC 2013-TN2654), the NRC staff has not found electric shock resulting from direct access to energized conductors or from induced charges in metallic structures to be a problem at most operating nuclear power plants. Generally, the NRC staff also does not expect electric shock from such sources to be a human health hazard during the SLR period. However, a site-specific review is required to determine the significance of the electric shock potential along the portions of the transmission lines that are within the scope of this EIS. Transmission lines that are within the scope of the NRC's SLR environmental review are limited to (1) those transmission lines that connect the nuclear power plant to the substation where electricity is fed into the regional distribution system and (2) those transmission lines that supply power to the nuclear power plant from the grid (NRC 2013-TN2654).

As discussed in Section 2.1.6.5, "Power Transmission Systems," of this EIS, the only transmission lines that are in scope for North Anna SLR are onsite. Specifically, there are seven in-scope transmission lines of which three have been placed underground. The nuclear power plant is connected to the switchyard by two overhead 500 kilovolt (kV) transmission lines, three 34.5 kV underground lines, and two 34.5 kV overhead lines (VEPCO 2020-TN8099). There is no potential shock hazard to offsite members of the public from these onsite transmission lines.

For occupational electric shock hazards, OSHA implemented the regulation in 29 CFR 1926.964, "Overhead Lines and Live-Line Barehand Work," in April 2014 (79 FR 20316-TN8528) for work performed on or near overhead lines and equipment and for live-line barehand work. A note to 29 CFR 1926.964(b)(4) (TN4455), "Induced Voltage," sets specific overhead line safety limits:

> If the employer takes no precautions to protect employees from hazards associated with involuntary reactions from electric shock, a hazard exists if the induced voltage is sufficient to pass a current of 1 milliampere through a 500-ohm resistor. If the employer protects employees from injury due to involuntary reactions from electric shock, a hazard exists if the resultant current would be more than 6 milliamperes.

As stated in Section E3.10.2, "Electric Shock Hazards," of the ER, Dominion adheres to the National Electric Safety Code (NESC) compliance requirements for occupational shock hazard avoidance through implementation of the Dominion engineering manual and the Dominion Blue Book (VEPCO 2020-TN8099). Dominion must also adhere to OSHA's occupational safety regulations. These regulations and guidance documents ensure all necessary mitigation measures are incorporated for maintaining worker and visitor safety through design ground clearances and other shock prevention measures applicable to the in-scope transmission lines. Additionally, in October 2018, Dominion Energy Electric Transmission personnel investigated the potential for electric shock by induced current in the vicinity of the four overhead transmission lines and found the worst-case situation would be less than the 2012 NESC standard of 5 milliamperes (VEPCO 2021-TN8524) and OSHA regulation of 6 milliamperes as incorporated into Dominion safety documents.

3.11.6 Proposed Action

The following sections address the site-specific environmental impacts of North Anna SLR on the environmental issues identified in Table 3-1 that relate to human health.

3.11.6.1 Radiation Exposures to The Public

Nuclear power plants, under controlled conditions, release small amounts of radioactive materials to the environment during normal operation. NRC regulations in 10 CFR Part 20-TN283 identify maximum allowable concentrations of radionuclides that can be released from a licensed facility, such as North Anna, into the air and water above background at the boundary of unrestricted areas to control radiation exposures of the public and releases of radioactivity. These concentrations are derived based on an annual total effective dose equivalent of 0.1 rem to individual members of the public. In addition, pursuant to 10 CFR 50.36(a), nuclear power reactors have special license conditions called technical specifications for radioactive gaseous and liquid releases from the plant that are required to minimize the radiological impacts associated with plant operations to levels that are ALARA (TN249).

Radioactive waste management systems are incorporated into the design of each plant. They are designed to remove most of the fission product radioactivity that leaks from the fuel, as well as most of the activation- and corrosion-product radioactivity produced by neutrons in the vicinity of the reactor core. The amounts of radioactivity released through vents and discharge points to areas outside the plant boundary are recorded and published annually in the radioactive effluent release reports. These environmental monitoring programs are in place at all plants. Because there is no reason to expect effluents to increase at North Anna during the SLR term, doses from continued operation are expected to be well within regulatory limits established in 10 CFR Part 20-TN283 and 40 CFR Part 190-TN739, "Environmental Radiation Protection Standards for Nuclear Power Operations." No mitigation measures beyond those implemented under the licenses would be warranted because current mitigation practices have kept public radiation doses well below regulatory standards and are expected to continue to do so.

The NRC reviewed effluent release reports from years 2018 – 2022 (VEPCO 2019-TN8392, 2020-TN8393, 2021-TN8394, VEPCO 2022-TN8476, VEPCO 2023-TN8529) and the results indicated that the annual public dose is a fraction of the regulatory limits and were in accordance with radiation protection standards identified within 10 CFR Part 50-TN249 (Appendix I), 10 CFR Part 20-TN283, and 40 CFR Part 190-TN739. This 5-year period provided a dataset that covered a broad range of activities that occur at a nuclear power plant, such as refueling outages, routine operation, and maintenance that can affect the generation and release of radioactive effluents into the environment. The NRC staff looked for indications of adverse trends (e.g., increasing radioactivity levels) over the period of 2018 through 2022. Based on its review of this information, the NRC staff found no apparent increasing trend in concentration or pattern indicating either a new inadvertent release or persistently high tritium concentrations that might indicate an ongoing inadvertent release from North Anna. The groundwater monitoring program at North Anna is robust, and any future leaks that might occur during the subsequent license renewal period should be readily detected. All spills are well monitored, characterized, and actively remediated. Taken together, the data show that there were no significant radiological impacts to the environment from operations at North Anna.

Radiation doses to the public from continued operation are expected to continue at current levels and would remain below the regulatory limits during the SLR term. The NRC staff identified no information for North Anna that would result in different impacts than those of current operations. The NRC staff concludes that the health impacts from public radiation exposure due to continued nuclear plant operations at North Anna during the SLR term would be SMALL based on public doses being maintained within regulatory limits.

3.11.6.2 Radiation Exposures to Plant Workers

Nuclear plant workers conducting activities involving radioactively contaminated systems or working in radiation areas can be exposed to radiation. Individual occupational doses are measured by nuclear power plant licensees as required by the basic NRC radiation protection standard, 10 CFR Part 20-TN283. Most of the occupational radiation dose to nuclear plant workers results from external radiation exposure rather than from internal exposure from inhaled or ingested radioactive materials. Workers also receive radiation exposure during the storage and handling of radioactive waste. Occupational doses for continued operations during the subsequent license renewal term are expected to be similar to the doses during the current operations and bounded by the analysis conducted in the 1996 LR GEIS. It is estimated that the occupational doses would be much less than the regulatory dose limits.

Under 10 CFR 20.2206, “Reports of individual monitoring,” the NRC requires nuclear plant licensees to submit an annual report of the results of individual monitoring carried out by the licensee for each individual for whom monitoring was required by (10 CFR Part 20-TN283), “Conditions requiring individual monitoring of external and internal occupational dose,” during that year. The NRC staff has reviewed the North Anna occupational dose reports and summary reports through 2020 (NRC 2022-TN8530) and identified no new information at North Anna that would result in different impacts than current operations. The NRC staff concludes that the health impacts from occupational radiation exposure due to continued operations at North Anna during the SLR term would be SMALL based on individual worker doses being maintained within 10 CFR Part 20 limits. No mitigation measures beyond those implemented during the current license term would be warranted, because the ALARA process continues to be effective in reducing radiation doses.

3.11.6.3 Human Health Impact from Chemicals

State and Federal environmental agencies regulate the use, storage, and discharge of chemicals, biocides, and sanitary wastes. Such environmental agencies also regulate how facilities like North Anna manage minor chemical spills. Chemical and hazardous wastes can potentially impact workers, members of the public, and the environment.

Dominion currently controls the use, storage, and discharge of chemicals and sanitary wastes at North Anna in accordance with its chemical control procedures, waste-management procedures, and North Anna site-specific chemical spill prevention plans. Dominion monitors and controls discharges of chemical and sanitary wastes through North Anna's NPDES permit process. These plant procedures, plans, and processes are designed to prevent and minimize the potential for a chemical or hazardous waste release and, in the event of such a release, minimize impact to workers, members of the public, and the environment. The NRC staff concludes that the health impacts from chemicals due to continued nuclear power plant operations at North Anna during the SLR term would be SMALL based on these procedures, plans, and processes.

3.11.6.4 Microbiological Hazards to the Public (Nuclear Power Plants with Cooling Ponds or Canals or Cooling Towers That Discharge to a River)

This section evaluates the effects of thermophilic microorganisms on the public for nuclear power plants using cooling ponds, lakes, or canals or cooling towers that discharge to a river.

Based on the information presented in Section 3.11.3, "Microbiological Hazards," the thermophilic organisms most likely to be of potential concern in Lake Anna are *N. fowleri*, a free-living amoeba that causes the infection human PAM, and cyanobacteria, which can cause harmful algal blooms that can result in skin rash and gastrointestinal illnesses in exposed individuals. The public could be exposed to these microorganisms during swimming, boating, fishing, and other recreational uses of Lake Anna.

As discussed in Section 3.11.3, all other thermophilic microorganisms identified in the LR GEIS that may be associated with thermal effluents of nuclear power plants are not specifically of concern at North Anna or within Lake Anna. These include *Salmonella typhimurium, S. enteritidis*, *Shigella* species, *Pseudomonas aeruginosa*, and *Legionella* species.

Naegleria fowleri

With respect to *N. fowleri*, this organism is known to be present in Lake Anna. However, North Anna's thermal effluent discharge is below the organism's optimal growth temperature of 115°F (46°C) (see Table 3-30), and public access to the WHTF, where temperatures are highest, is restricted to adjacent private property owners. Thus, the North Anna thermal discharges are not high enough in temperature to facilitate proliferation of this microorganism or to cause a public health concern. There have been no known occurrences of PAM from Lake Anna over the 42-year period since the organism was discovered, and the proposed action would not result in any operational changes that would affect thermal effluent temperature or otherwise create favorable conditions for *N. fowleri* growth. Additionally, to better inform the public and to mitigate the potential health risk associated with *N. fowleri* and other thermophilic microorganisms, Dominion began posting WHTF lagoon temperatures online at the recommendation of VDH. The ability of the public to make temperature-informed water recreation decisions would mitigate the already small risk of exposure to *N. fowleri*. During the proposed SLR term, Dominion would continue monitoring and posting WHTF lagoon temperatures, which would ensure that the public health risk from *N. fowleri* exposure remains low.

Harmful Algal Blooms

With respect to cyanobacteria, the appearance of harmful algal blooms in Lake Anna is a relatively new issue that first occurred in the summer of 2018. Blooms have been reported within the WHTF as well as from multiple arms of Lake Anna that are not influenced by North Anna thermal discharges. The widespread occurrence of these blooms indicates that there are contributing factors beyond North Anna operations. North Anna thermal discharges may contribute to favorable bloom conditions within and near the WHTF, but other conditions must also be present for blooms to occur. These include lower water clarity and higher nutrient concentrations, which are factors that would not be associated with North Anna operations. North Anna operations are unlikely to contribute to blooms that occur beyond the reach of the North Anna thermal plume, such as the various arms of Lake Anna identified in Table 3-31, many of which are several miles from North Anna.

The VDH and Dominion have developed monitoring programs to sample suspected blooms and issue no-swim advisories when necessary. The VDH monitors Lake Anna, and Dominion performs sampling in the WHTF. Dominion posts advisory information online and also physically posts advisory signs at the access gates to the common areas of nearby residential subdivisions to warn members of the public recreating near affected areas (VEPCO 2021-TN8524). As indicated in the preceding paragraph, Dominion also posts WHTF lagoon temperatures on its website. These measures collectively minimize the risk that members of the public would be exposed to cyanobacteria in concentrations that could pose a health risk. During the proposed SLR term, Dominion would continue monitoring cyanobacteria, issuing advisories, and coordinating with VDH on harmful algal blooms (VEPCO 2021-TN8524), all of which would ensure that the public health risk from cyanobacteria exposure remains low.

Conclusion

The thermophilic microorganisms *N. fowleri* and cyanobacteria can pose public health concerns in recreational-use waters such as Lake Anna when these organisms are present in high enough concentrations to cause infection. Based on the previously discussed NRC staff analysis, continued thermal effluent discharges from North Anna during the proposed SLR term would not contribute to the proliferation of *N. fowleri*. No infections are known to have occurred from Lake Anna, and none are expected during the proposed SLR term.

Thermal effluent discharges may contribute to the growth of cyanobacteria in the WHTF. Notably, however, temperature is only one of several factors necessary for a harmful algal bloom to occur. Dominion has instituted monitoring and mitigation strategies to limit public exposure to potentially harmful conditions when blooms are present. Dominion also coordinates with the VDH concerning this issue, and the NRC staff assumes that the VDH would use its authority to implement any further mitigation it deems necessary to protect the public.

The NRC staff concludes that the impacts of thermophilic microorganisms on the public are SMALL for the proposed North Anna SLR.

3.11.6.5 Microbiological Hazards to Plant Workers

No change in existing microbiological hazards to plant workers is expected due to SLR, for the same reasons discussed in detail in the 2013 LR GEIS for initial license renewal. It is considered unlikely that any plants that have not already experienced occupational microbiological hazards would do so during the SLR term or that hazards would increase during the SLR term. The NRC staff identified no information or situations that would result in different impacts for this issue for the SLR term and expects Dominion to continue to employ at proven industrial hygiene principles at North Anna. As a result, the NRC staff concludes that adverse occupational health effects associated with microorganisms due to continued nuclear power plant operations at North Anna during the SLR term would be of SMALL significance, and no mitigation measures beyond those implemented during the current license term would be warranted.

3.11.6.6 Chronic Effects of Electromagnetic Fields (EMFs)

The LR GEIS (NRC 2013-TN2654) and 10 CFR Part 51 (TN250), Subpart A, Appendix B do not designate the chronic effects of 60-hertz EMFs from power lines as either a Category 1 or Category 2 issue. Until a scientific consensus is reached on the health implications of EMFs, the NRC will not include them as either a Category 1 or a Category 2 issue.

Scientific consensus on the health implications of EMFs has not been established. The potential for chronic effects from these fields continues to be studied and is not known at this time. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the U.S. Department of Energy (DOE). The NIEHS (1999-TN78) report contains the following conclusion:

> The NIEHS concludes that ELF-EMF (extremely low frequency electromagnetic field) exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. The NIEHS does not believe that other cancers or noncancer health outcomes provide sufficient evidence of a risk to currently warrant concern.

This statement did not cause the NRC to change its position with respect to the chronic effects of EMFs. The NRC staff considers the impacts to be “UNCERTAIN.”

3.11.6.7 Physical Occupational Hazards

Nuclear power plants are industrial facilities that have many of the typical occupational hazards found at any other electric power generation utility. Nuclear power plant workers may perform electrical work, electric powerline maintenance, repair work, and maintenance activities and may be exposed to potentially hazardous physical conditions (e.g., falls, excessive heat, cold, noise, electric shock, and pressure).

The OSHA is responsible for developing and enforcing workplace safety regulations. With specific regard to nuclear power plants, plant conditions that result in an occupational risk, but do not affect the safety of licensed radioactive materials, are under the statutory authority of OSHA rather than the NRC as set forth in a memorandum of understanding (NRC 2013-TN7766) between the NRC and OSHA. Occupational hazards are reduced when workers adhere to safety standards and use appropriate protective equipment; however, fatalities and injuries from accidents may still occur. North Anna maintains an occupational safety program for its workers in accordance with OSHA regulations. The NRC staff identified no information or situations that would result in different impacts for this issue for this SLR term at North Anna. The NRC staff expects that Dominion will continue to employ an occupational safety program so that physical occupational hazards due to continued nuclear power plant operations at North Anna during the SLR term are minimized. As a result, the NRC staff concludes that the potential impacts related to physical occupational hazards during the SLR term would be SMALL.

3.11.6.8 Electric Shock Hazards

Based on the LR GEIS (NRC 2013-TN2654) the Commission found that electric shock resulting from direct access to energized conductors or from induced charges in metallic structures has not been identified as a problem at most operating nuclear power plants and generally is not expected to be a problem during the license renewal term. However, a site-specific review is required to determine the significance of the electric shock potential along the portions of the transmission lines that are within the scope of North Anna SLR review.

As discussed in Section 3.11.5, "Other Hazards," there are no offsite transmission lines that are in scope for this EIS. Therefore, there are no potential impacts on members of the public. There are four onsite overhead transmission lines with the potential for electric shock to workers through induced currents. To address this occupational hazard, Dominion adheres to NESC code and OSHA compliance requirements for shock hazard avoidance, as supported by a corresponding investigation of the before-mentioned overhead transmission lines. As discussed in Section 3.11.5, North Anna maintains an occupational safety program for its workers in accordance with OSHA regulations, which includes protection from acute electric shock. Therefore, the NRC staff concludes that the potential impacts from acute electric shock during the SLR term would be SMALL.

3.11.6.9 Postulated Accidents

This section considers two environmental issues identified in Table 3-1: design-basis accidents and SAMAs.

There are two classes of postulated accidents as they relate to nuclear power plants:

- Design-Basis Accidents: Postulated accidents that a nuclear facility must be designed and built to withstand without loss to the systems, structures, and components necessary to ensure public health and safety.
- Severe Accidents: Postulated accidents that are more severe than design-basis accidents because they could result in substantial damage to the reactor core.

For design-basis accidents, site-specific analysis of design-basis accidents is in the North Anna Updated Final Safety Analysis Report (UFSAR). For plant changes during the North Anna PEO, the validity of the UFSAR is maintained in compliance with 10 CFR 50.59, "Changes, tests and experiment." The UFSAR design-basis accident analysis forms the technical bases for the North Anna Technical Specifications for operation. The UFSAR and Technical Specification are parts of the current licensing basis and are the subject of the NRC oversight program for operation during PEO. Therefore, NRC staff concludes that the impacts of design-basis accidents are of SMALL significance. Appendix F contains additional discussion on North Anna postulated accidents.

For severe accidents, staff performed a site-specific analysis in Appendix F. Based on information in this analysis, the NRC staff concludes that the environmental impacts of severe accidents associated with license renewal are SMALL, with the following caveat:

> The probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts from severe accidents are SMALL for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives. [NRC 2013-TN2654]

Dominion's 2001 ER, submitted as part of its initial license renewal application, included an assessment of SAMAs for North Anna (VEPCO 2001-TN8297). The NRC staff at that time reviewed Dominion's 2001 analysis of SAMAs for North Anna and documented this review in its SEIS for the initial license renewal, which the NRC published in 2002, as Supplement 7 to NUREG-1437 (NRC 2002-TN665). Because the NRC staff has previously considered SAMAs for North Anna, Dominion is not required to perform another SAMA analysis for its SLR application (10 CFR 51.53(c)(3)(ii)(L)) (TN250).

However, the NRC's regulations at 10 CFR Part 51 (TN250), which implement NEPA Section 102(2), require that (1) all applicants for license renewal submit an ER to the NRC and (2) in the ER, the applicant is to identify any "new and significant information regarding the environmental impacts of license renewal of which the applicant is aware" (10 CFR 51.53(c)(3)(iv)) (TN250). This includes new and significant information that could affect the environmental impacts related to postulated severe accidents or that could affect the results of a previous SAMA assessment. Accordingly, in its 2021 SLR application ER, Dominion evaluated areas of new and potentially significant information that could affect the environmental impact of postulated severe accidents during the SLR period. The NRC staff discusses new information pertaining to SAMAs in Appendix F, "Environmental Impacts of Postulated Accidents," in this EIS.

Based on the NRC staff's review and evaluation of Dominion's analysis of new and potentially significant information regarding SAMAs and the staff's independent analyses as documented in Appendix F of this EIS, the staff finds that there is no new and significant information for North Anna related to SAMAs.

3.11.7 No-Action Alternative

Under the no-action alternative, the NRC would not issue subsequent renewed licenses, and North Anna would shut down on or before the expiration of the current renewed licenses. Human health risks would be smaller following nuclear power plant shutdown. The reactor units, which currently operate within regulatory limits, would emit less radioactive gaseous, liquid, and solid material to the environment. In addition, following shutdown, the variety of potential accidents at the nuclear power plant (radiological or industrial) would be reduced to a limited set associated with shutdown events and fuel handling and storage. In Section 3.11.6, "Proposed Action," the NRC staff concluded that the impacts of continued nuclear power plant operation on human health would be SMALL, except for "Chronic effects of electromagnetic fields (EMFs)," for which the impacts are UNCERTAIN. In Section 3.11.6.9, "Environmental Consequences of Postulated Accidents," the NRC staff concluded that the impacts of accidents during operation are SMALL. Therefore, as radioactive emissions to the environment decrease, and as the likelihood and types of accidents decrease following shutdown, the NRC staff concludes that the risk to human health following nuclear power plant shutdown would be SMALL.

3.11.8 Replacement Power Alternatives: Common Impacts

Impacts on human health from construction of a replacement power station would be similar to impacts associated with the construction of any major industrial facility. Compliance with worker protection rules, the use of personal protective equipment, training, and placement of engineered barriers would limit those impacts on workers to acceptable levels.

The human health impacts from the operation of a power station include public risk from inhalation of gaseous emissions. Regulatory agencies, including the EPA and Virginia State agencies, base air emission standards and requirements on human health impacts. These agencies also impose site-specific emission limits to protect human health.

3.11.9 New Nuclear (Small Modular Reactor) Alternative

The construction impacts of the new nuclear alternative would include those identified in Section 3.11.8 as common to all replacement power alternatives. The NRC staff expects that the licensee would limit access to active construction areas to only authorized individuals. As a result, the NRC staff concludes that the impacts on human health from the construction of five new SMRs would be SMALL.

The human health effects from the operation of the new nuclear alternative would be similar to those of operating the existing North Anna. Small modular reactor designs would use the same type of fuel (i.e., form of the fuel, enrichment, burnup, and fuel cladding) as those nuclear power plants considered in the NRC staff's evaluation in the LR GEIS (NRC 2013-TN2654). As such, their impacts would be similar to North Anna. As presented in Section 3.11.6.3, impacts on human health from the operation of North Anna would be SMALL, except for "chronic effects of electromagnetic fields (EMFs)," for which the impacts are UNCERTAIN. Therefore, the NRC staff concludes that the impacts on human health from the operation of the new nuclear alternative would be SMALL.

3.11.10 Combination Alternative (Solar, Offshore Wind, Small Modular Reactor, and Demand-Side Management)

Impacts on human health from construction of the combination alternative would include those identified in Section 3.11.8 as common to the construction of all replacement power alternatives. Because the NRC staff expects that the builder will limit access to the active construction area to only authorized individuals, the impacts on human health from the construction of the combination SMR and solar alternative would be SMALL.

Solar photovoltaic panels are encased in heavy-duty glass or plastic. Therefore, there is little risk that the small amounts of hazardous semiconductor material that they contain would be released into the environment. In the event of a fire, hazardous particulate matter could be released to the atmosphere. Given the short duration of fires and the high melting points of the materials found in the solar photovoltaic panels, the impacts from inhalation are minimal. Also, the risk of fire at ground-mounted solar photovoltaic installations is minimal due to precautions taken during site preparation, such as the removal of fuels and the lack of burnable materials contained in the solar photovoltaic panels. Another potential risk associated with solar photovoltaic systems and fire is the potential for shock or electrocution from contact with a high-voltage conductor. Proper procedures and clear marking of system components should be used to provide emergency responders with appropriate warnings to diminish the risk of shock or electrocution (Parametrix Undated-TN8599).

Solar photovoltaic panels do not produce EMFs at levels considered harmful to human health, as established by the International Commission on Non-Ionizing Radiation Protection. These small EMFs diminish significantly with distance and are indistinguishable from normal background levels within several yards (Parametrix Undated-TN8599).

Operational hazards at a wind facility for the workforce include working at heights, working near rotating mechanical or electrically energized equipment, and working in extreme weather. Adherence to safety standards and the use of appropriate protective equipment through implementation of an OSHA-approved worker safety program would minimize occupational hazards. Potential impacts on workers and the public include ice thrown from rotor blades and broken blades thrown as a result of mechanical failure. Adherence to proper worker safety procedures and limiting public access to wind turbine sites would minimize the impacts from ice thrown and broken rotor blades. Potential impacts also include EMF exposure, aviation safety hazards, and exposure to noise and vibration from the rotating blades. Impacts from EMF exposure would be minimized by adherence to proper worker safety procedures and limiting public access to any components that could create an EMF. Aviation safety hazards would be minimized by proper siting of the wind turbine facilities and maintaining all proper safety warning devices, such as indicator lights, for pilot visibility. Offshore installation of wind facilities would preclude any potential human health effects from noise and vibration. Furthermore, the NRC staff has identified no epidemiologic studies on noise and vibration from wind turbines that would suggest any direct human health impact. Based on this information, the human health impacts from the operation of the wind component for the combination alternative would be SMALL.

Construction impacts for the demand-side management portion of this alternative would be minimal and localized to activities such as weatherization efficiency of an end-user's home or facility (NRC 2013-TN2654). Impacts on human health from the construction activities involved in the demand-side management portion of this alternative would be SMALL.

Operational hazard impacts for the demand-side management portion of this alternative would be minimal and localized to activities such as weatherization efficiency of an end-user's home or facility. The LR GEIS notes that the environmental impacts are likely to center on indoor air quality (NRC 2013-TN2654). This is because of increased weatherization of the home in the form of extra insulation and reduced air turnover rates from the reduction in air leaks. However, the actual impact is highly site-specific and not yet well established. Impacts on human health from the operational hazard activities involved in the demand-side management portion of this alternative would be SMALL.

Therefore, given the expected compliance with worker and environmental protection rules and the use of personal protective equipment, training, and engineered barriers, the NRC staff concludes that the potential human health impacts for the combination alternative would be SMALL.

3.12 Environmental Justice

Under Executive Order 12898 (59 FR 7629-TN1450), Federal agencies are responsible for identifying and addressing, as appropriate, disproportionate and adverse human health and environmental impacts on minority and low-income populations. Independent Federal agencies, such as the NRC, are not bound by the terms of EO 12898 but are "requested to comply with the provisions of [the] order." In 2004, the Commission issued the agency's "Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions" (69 FR 52040-TN1009), which states, "The Commission is committed to the general goals set forth in Executive Order 12898 and strives to meet those goals as part of its NEPA review process."

The Council on Environmental Quality (CEQ) provides the following information in "Environmental Justice: Guidance Under the National Environmental Policy Act" (CEQ 1997-TN452):

Disproportionately High and Adverse Human Health Effects

> Adverse health effects are measured in risks and rates that could result in latent cancer fatalities, as well as other fatal or nonfatal adverse impacts on human health. Adverse health effects may include bodily impairment, infirmity, illness, or death. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant (as employed by NEPA) and appreciably exceeds the risk or exposure rate for the general population or for another appropriate comparison group (CEQ 1997-TN452).

Disproportionately High and Adverse Environmental Effects

> A disproportionately high environmental impact that is significant (as employed by NEPA) refers to an impact or risk of an impact on the natural or physical environment in a low-income or minority community that appreciably exceeds the environmental impact on the larger community. Such effects may include ecological, cultural, human health, economic, or social impacts. An adverse environmental impact is an impact that is determined to be both harmful and significant (as employed by NEPA). In assessing cultural and aesthetic environmental impacts, impacts that uniquely affect geographically dislocated or dispersed minority or low-income populations or American Indian tribes are considered (CEQ 1997-TN452).

This environmental justice analysis assesses the potential for disproportionate and adverse human health or environmental effects on minority and low-income populations that could result from the continued operation of North Anna Units 1 and 2 associated with the proposed action (license renewal) and alternatives to the proposed action. In assessing the impacts, the following definitions of minority individuals, minority populations, and low-income population were used (CEQ 1997-TN452):

- Minority Individuals. Individuals who identify themselves as members of the following population groups: Hispanic or Latino, American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, or two or more races, meaning individuals who identified themselves on a census form as being a member of two or more races, for example, White and Asian.
- Minority Populations. Minority populations are identified when (1) the minority population of an affected area exceeds 50 percent or (2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.
- Low-income Population. Low-income populations in an affected area are identified with the annual statistical poverty thresholds from the Census Bureau's Current Population Reports, Series P60, on Income and Poverty.

In determining the location of minority and/or low-income populations, the NRC uses a 50 mi (80 km) radius from the facility as the geographic area to perform a comparative analysis. The 50 mi (80 km) radius is consistent with the impact analysis conducted for human health impacts. The NRC compares the percentage of minority and/or low-income populations in the 50 mi (80 km) geographic area to the percentage of minority and/or low-income populations in each census block group to determine which block groups exceed the regional percentage (or 50 percent, whichever is lower), thereby identifying the location of these populations (NRC 2020-TN6399).

3.12.1 Minority Population

According to the Census Bureau's 2020 Census data, approximately 43 percent of the population residing within a 50-mi (80-km) radius of North Anna identified themselves as minority individuals. The largest minority populations were Black or African American (approximately 21 percent), and Hispanic, Latino, or Spanish origin of any race (approximately 5 percent) (USCB 2020-TN9559).

The U.S. Census Bureau defines "block groups" as statistical divisions of census tracts, which are generally defined to contain between 600 and 3,000 people and are used to present data and control block numbering. A block group consists of clusters of blocks within the same census tract that have the same first digit in of their four-digit census block number (USCB 2022-TN9096). There are 1,466 total block groups within a 50 mi (80 km) radius of North Anna.

According to the CEQ, a minority population exists if the percentage of the minority population of an area (e.g., census block group) exceeds 50 percent or is meaningfully greater than the minority population percentage in the general population. This environmental justice analysis applied the meaningfully greater threshold in identifying higher concentrations of minority populations; meaningfully greater threshold is any percentage greater than the minority population within the 50-mi (80-km) radius. Therefore, for the purposes of identifying higher concentrations of minority populations, census block groups within the 50-mi (80-km) radius of North Anna were identified as minority population block groups if the percentage of the minority population in the block group exceeded 43 percent, the percent of the minority population within the 50-mi (80-km) radius of North Anna.

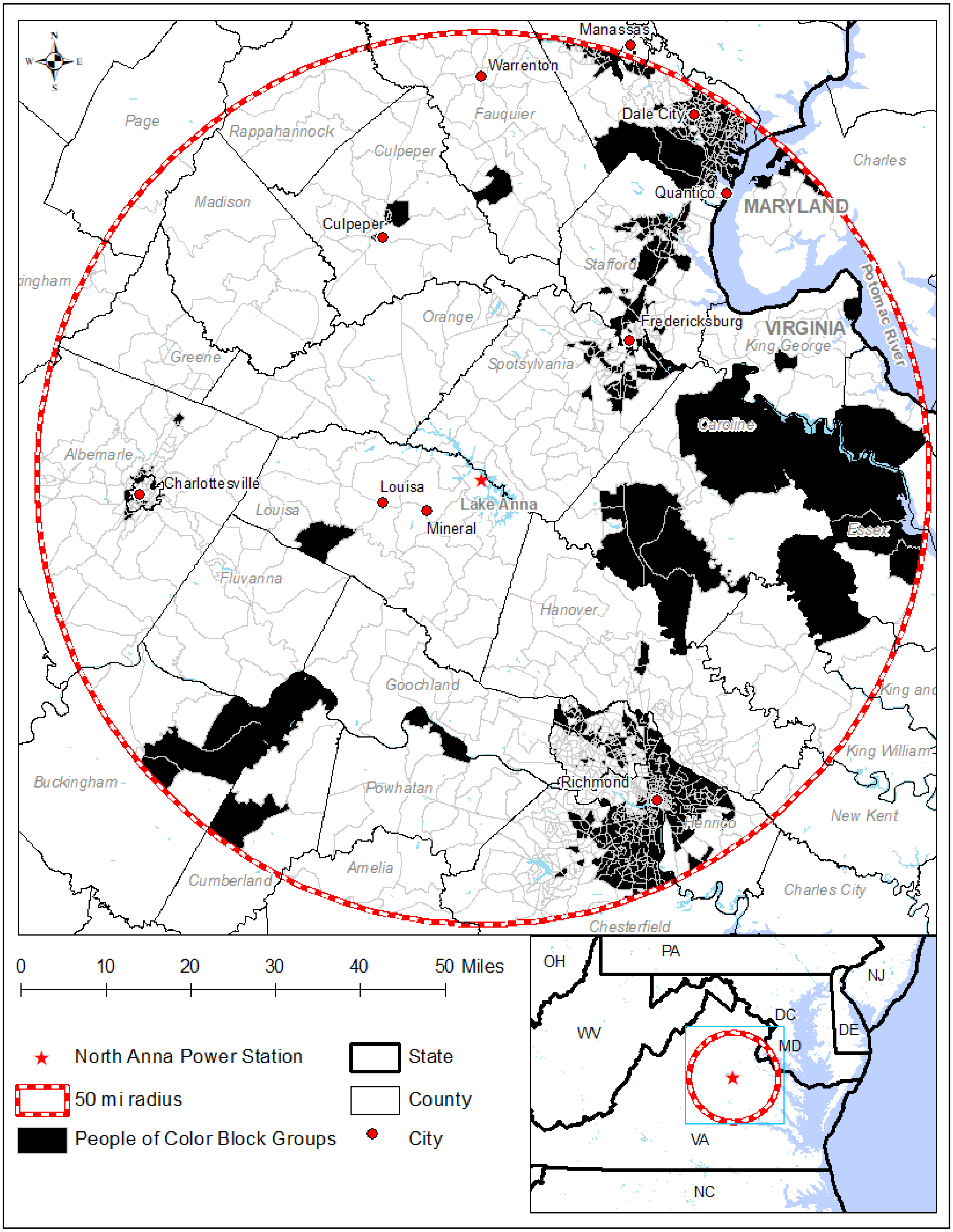
As shown in Figure 3-7, minority population block groups (race and ethnicity) are predominantly clustered north-northeast of North Anna toward Fredericksburg, Virginia; south-southeast of North Anna around Richmond, Virginia; and east of North Anna in Caroline and Essex counties. There are 637 minority population block groups (using the "meaningfully greater" threshold of 43 percent minority population) within the 50 mi (80 km) radius of North Anna. Based on this analysis, North Anna Units 1 and 2 are not located in a minority population block group.

According to 2020 Census data, minority populations in the socioeconomic ROI (Louisa and Orange counties) comprised 24 percent of the total two-county population (Table 3-23).Figure 3-7 shows predominantly minority population block groups, using 2020 census data for race and ethnicity, within a 50 mi (80 km) radius of North Anna.

3.12.2 Low-Income Population

The Census Bureau's 2017–2021 American Community Survey data identify approximately 9 percent of individuals and 6 percent of families residing within a 50 mi (80 km) radius of North Anna as living below the Federal poverty threshold in 2021. The 2021 Federal poverty threshold was $27,740 for a family of four USCB 2021-TN8833).

Figure 3-8 shows the location of low-income block groups within a 50 mi (80 km) radius of North Anna. Census block groups were considered low-income population block groups if the percentage of individuals living below the Federal poverty threshold within the block group exceeded 9 percent, which is the percent of individuals living below the Federal poverty threshold within the 50 mi (80 km) radius of North Anna.



1

2 **Figure 3-7 Minority Block Groups within a 50 mi (80 km) Radius of North Anna.**
3 **Adapted from: USCB 2020-TN9097.**

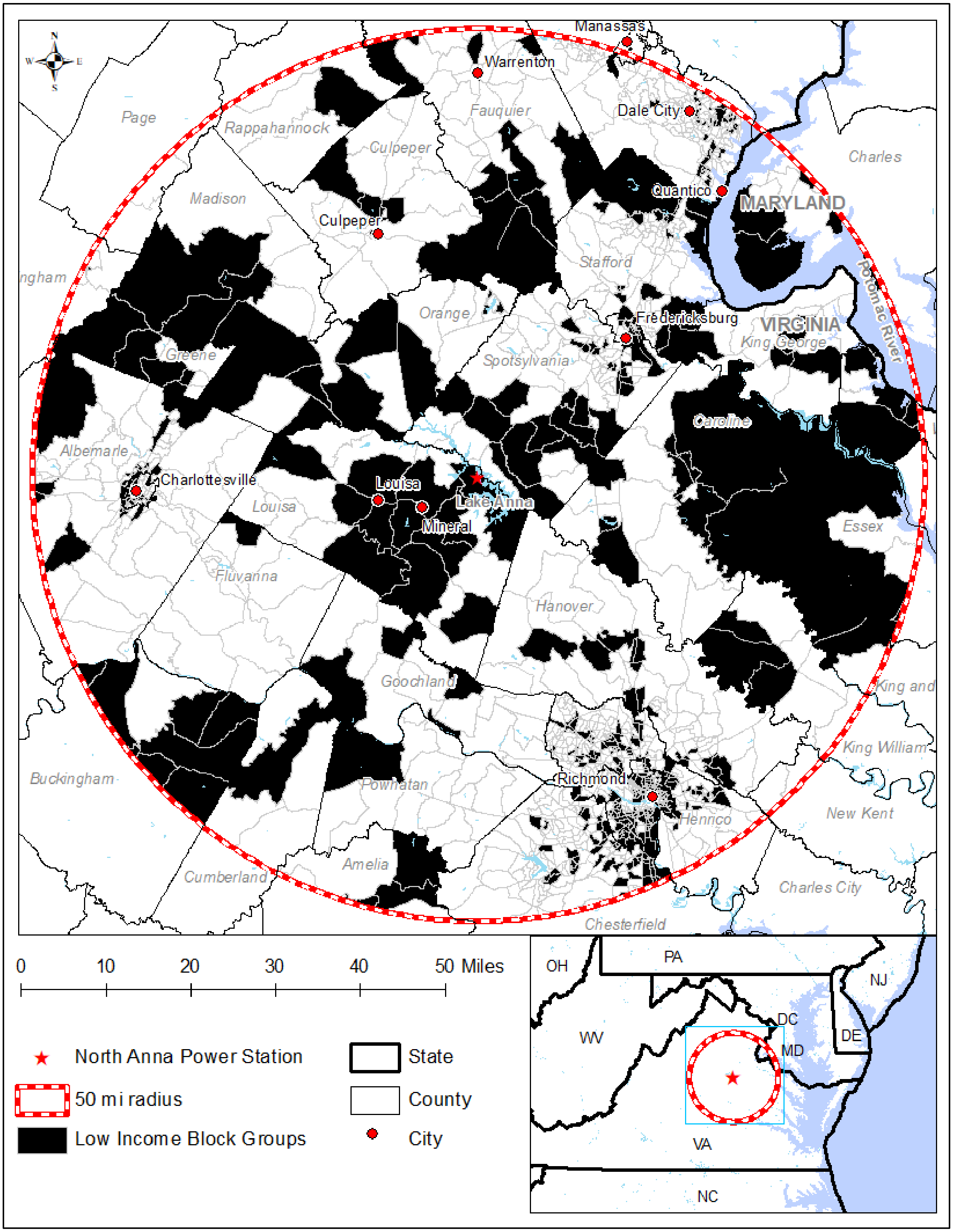


Figure 3-8 Low-Income Block Groups within a 50 mi (80 km) Radius of North Anna. Adapted from: USCB 2021-TN9098

As shown in Figure 3-8 low-income population block groups are located throughout the 50 mi (80 km) radius of North Anna. There are 536 low-income population block groups within a 50 mi (80 km) radius of North Anna. Based on this analysis, North Anna Units 1 and 2 are located in a low-income population block group.

As shown in Table 3-22, 6.8 percent of families and 9.9 percent of people in Virginia were living below the Federal poverty threshold, and the median household and per capita incomes for Virginia were $80,615 and $43,267, respectively. In the socioeconomic RIO, people living in Louisa County have lower median household and per capita incomes ($70,974 and $38,360, respectively), with similar percentages of families and people (6.8 percent and 10.8 percent, respectively) living below the poverty level. People living in Orange County also have lower median household and per capita incomes ($79,211 and $36,839, respectively), with higher percentages of families and people (8.7 percent and 11.3 percent, respectively) living below the official poverty level.

3.12.3 Proposed Action

The NRC addresses environmental justice matters for license renewal by (1) identifying the location of minority and low-income populations that may be affected by the continued operation of the nuclear power plant during the SLR term, (2) determining whether there would be any potential human health or environmental effects on these populations and special pathway receptors (groups or individuals with unique consumption practices and interactions with the environment), and (3) determining whether any of the effects may be disproportionate and adverse. Adverse health effects are measured in terms of the risk and rate of fatal or nonfatal adverse impacts on human health. Disproportionate and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population exceeds the risk or exposure rate for the general population or for another appropriate comparison group. Disproportionate environmental effects refer to impacts or risks of impacts on the natural or physical environment in a minority or low-income community that are appreciably exceed the environmental impact on the larger community. Such effects may include biological, cultural, economic, or social impacts.

Figure 3-7 and Figure 3-8 show the location of predominantly minority and low-income population block groups residing within a 50 mi (80 km) radius of North Anna, respectively. This area of impact is consistent with the 50 mi (80 km) impact analysis for public and occupational health and safety. This chapter presents the assessment of environmental and human health impacts for each resource area. The analyses of impacts for all environmental resource areas indicated that the impact from license renewal would be SMALL.

Potential impacts on minority and low-income populations (including migrant workers or Native Americans) would mostly consist of socioeconomic and radiological effects; however, radiation doses from continued operations during the SLR term are expected to continue at current levels, and they would remain within regulatory limits. Section 3.11.6.9 discusses the environmental impacts from postulated accidents that might occur during the SLR term, which include both design-basis and severe accidents. In both cases, the Commission has generically determined that impacts associated with design-basis accidents are small because nuclear power plants are designed and operated to withstand such accidents, and the probability-weighted consequences of severe accidents are small.

Therefore, based on this information and the analysis of human health and environmental impacts presented in this chapter, there would be no disproportionate and adverse human health and environmental effects on minority and low-income populations from the continued operation of North Anna Units 1 and 2 during the renewal term.

Subsistence Consumption of Fish and Wildlife

As part of addressing environmental justice concerns associated with license renewal, the NRC also assessed the potential radiological risk to special population groups (such as migrant workers or Native Americans) from exposure to radioactive material received through their unique consumption practices and interactions with the environment, including the subsistence consumption of fish and wildlife; consumption of native vegetation; contact with surface waters, sediments, and local produce; absorption of contaminants in sediments through the skin; and inhalation of airborne radioactive material released from the nuclear power plant during routine operation. The special pathway receptors analysis is an important part of the environmental justice analysis because consumption patterns may reflect the traditional or cultural practices of minority and low-income populations in the area, such as migrant workers or Native Americans. The results of this analysis are presented here.

Section 4–4 of Executive Order 12898, “Federal actions to address environmental justice in minority populations and low-income populations” (1994) (59 FR 7629-TN1450), directs Federal agencies, whenever practical and appropriate, to collect and analyze information about the consumption patterns of populations that rely principally on fish and wildlife for subsistence and to communicate the risks of these consumption patterns to the public. In this EIS, the NRC considered whether there were any means for minority or low-income populations to be disproportionately affected by examining impacts on American Indians, Hispanics, migrant workers, and other traditional lifestyle special pathway receptors. The assessment of special pathways considered the levels of radiological and nonradiological contaminants in fish, sediments, water, milk, and food products on or near North Anna Units 1 and 2.

Radionuclides released to the atmosphere may deposit on soil and vegetation and may therefore eventually be incorporated into the human food chain. To assess the impact of reactor operations on humans from the ingestion pathway, Dominion collects and analyzes samples of air, water, silt, shoreline sediment, aquatic biota, leafy vegetation, and direct exposure for radioactivity as part of its ongoing comprehensive radiological environmental monitoring program.

To assess the impact of nuclear power plant operations, samples are collected annually from the environment and analyzed for radioactivity. A nuclear power plant effect would be indicated if the radioactive material detected in samples were higher than background levels. Two types of samples are collected. The first type, a control sample, is collected from areas beyond the influence of the nuclear power plant or any other nuclear facility. These control samples are used as reference data to determine normal background levels of radiation in the environment. The second type of samples, indicator samples, are collected near the nuclear power plant from areas where any radioactivity contribution from the nuclear power plant would be at its highest concentration. These indicator samples are then compared to the control samples to evaluate the contribution of nuclear power plant operations to radiation or radioactivity levels in the environment. An effect would be indicated if the radioactivity levels detected in an indicator sample were larger or higher than the control sample or background levels.

Dominion collects samples from the aquatic and terrestrial environment near North Anna Units 1 and 2. The aquatic environment includes precipitation, surface, river and well water, silt and shoreline sediments, and fish from Lake Anna and Lake Orange (e.g., bass, sunfish, catfish), and shoreline sediment (Lake Anna). Aquatic monitoring results for 2021 showed naturally occurring radioactivity and radioactivity associated with fallout from past atmospheric nuclear weapons testing and were consistent with levels measured before North Anna Units 1 and 2 began operating. Dominion detected no radioactivity greater than the minimum detectable activity in any aquatic sample during 2021 and identified no adverse long-term trends in aquatic monitoring data (VEPCO 2022-TN8476).

The terrestrial environment includes airborne particulates, food products, and broad leaf vegetation. Terrestrial monitoring results for 2021 showed only naturally occurring radioactivity. The radioactivity levels detected were consistent with levels measured prior to the operation of North Anna Units 1 and 2. Dominion detected no radioactivity greater than the minimum detectable activity in any terrestrial samples during 2021. The terrestrial monitoring data also showed no adverse trends in the terrestrial environment (VEPCO 2022-TN8476)

Analyses performed on all samples collected from the environment at North Anna in 2021 showed no significant measurable radiological constituent above background levels. Overall, radioactivity levels detected in 2021 were consistent with previous levels as well as radioactivity levels measured prior to the operation of North Anna Units 1 and 2. Radiological environmental monitoring program sampling in 2021 did not identify any radioactivity above background or the minimum detectable activity (VEPCO 2022-TN8476).

Based on the radiological environmental monitoring data, the NRC staff concludes that special pathway receptor populations in the region would not likely experience disproportionate and adverse human health impacts because of subsistence consumption. In addition, the continued operation of North Anna Units 1 and 2 would not have disproportionate and adverse human health and environmental effects on these populations.

3.12.4 No-Action Alternative

Under the no-action alternative, the NRC would not renew the operating licenses, and North Anna Units 1 and 2 would shut down on or before the expiration of the current facility operating license. Impacts on minority and low-income populations would depend on the number of jobs and the amount of tax revenues lost in communities located near the nuclear power plant after reactor operations cease. Not renewing the operating licenses and terminating reactor operations could have a noticeable impact on socioeconomic conditions in the communities near North Anna. The loss of jobs and income could have an immediate socioeconomic impact. Some, but not all, of the over 900 workers could leave the area. In addition, the nuclear power plant would generate less tax revenue, which could reduce the availability of public services. This reduction could disproportionately affect minority and low-income populations that may have become dependent on these services.

3.12.5 Replacement Power Alternatives: Common Impacts

The following discussions identify common impacts from the construction and operation of replacement power facilities that could disproportionately affect minority and low-income populations. The NRC cannot determine if any of the replacement power alternatives would result in disproportionate and adverse human health and environmental effects on minority and low-income populations. This determination would depend on the site location, plant design, operational characteristics of the new facility, unique consumption practices and interactions with the environment of nearby populations, and the location of predominantly minority and low-income populations.

Construction

Potential impacts on minority and low-income populations from the construction of a replacement power plant would mostly consist of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). The extent of the effects experienced by these populations is difficult to determine because it would depend on the location of the power plant and transportation routes. Noise and dust impacts from construction would be short term and primarily limited to onsite activities. Minority and low-income populations residing along site access roads would be affected by increased truck and commuter vehicular traffic during construction, especially during shift changes. However, these effects would be temporary, limited to certain hours of the day, and would not likely be high and adverse. Increased demand for rental housing during construction could disproportionately affect low-income populations reliant on low-cost housing. However, given the proximity of North Anna to the Richmond, Virginia, and Washington, D.C., metropolitan areas, construction workers could commute to the site, thereby reducing the demand for local rental housing.

Operation

Low-income populations living near the new power plant that rely on subsistence consumption of fish and wildlife could be disproportionately affected. Emissions during power plant operations could also disproportionately affect nearby minority and low-income populations, depending on the type of replacement power. However, permitted air emissions are expected to remain within regulatory standards during operations.

3.12.6 New Nuclear (Small Modular Reactor) Alternative

Potential impacts on minority and low-income populations during the construction and operation of new nuclear power plant would be similar to the impacts described above in Section 3.12.5. Potential impacts during nuclear power plant operations would mostly consist of radiological effects; however, radiation doses would be well within regulatory limits.

3.12.7 Combination Alternative (Solar, Offshore Wind, Small Modular Reactor, and Demand-Side Management)

Potential impacts on minority and low-income populations from the construction and operation of a new SMR and the installation of solar photovoltaic units would be similar to the construction and operation impacts described above in Section 3.12.5. Minority and low-income populations could benefit from weatherization and insulation programs in a demand-side management energy conservation program. This could have a greater effect on low-income populations than the general population, as low-income households generally experience greater home energy burdens than the average household. Conversely, more costly utility bills due to increasing power costs could disproportionately affect low-income populations. However, programs such as the Federal Low Income Home Energy Assistance Program and the Virginia Energy Assistance Program are available to assist low-income families in paying for electricity.

3.13 Waste Management

Like any operating nuclear power plant, North Anna will produce both radioactive and nonradioactive waste during the SLR period. This section describes waste management and pollution prevention at North Anna. The description of these waste management activities is followed by the staff’s analysis of the potential impacts of waste management activities from the proposed action (SLR) and alternatives to the proposed action.

3.13.1 Radioactive Waste

As discussed in Section 2.1.4, "Radioactive Waste Management Systems," of this EIS, North Anna uses liquid, gaseous, and solid waste processing systems to collect and treat, as needed, radioactive materials produced as a byproduct of nuclear power plant operations. Each of the liquid, solid, and gaseous waste disposal systems is designed to serve both reactor units. Radioactive materials in liquid, gaseous, and solid effluents are reduced prior to being released into the environment so that the resultant dose to members of the public from these effluents is well within the NRC and the EPA dose standards. Radionuclides that can be efficiently removed from the liquid and gaseous effluents prior to release are converted to a solid waste form for disposal in a licensed disposal facility.

3.13.2 Nonradioactive Waste

Waste minimization and pollution prevention are important elements of operations at all nuclear power plants. Licensees are required to consider pollution prevention measures as dictated by the Pollution Prevention Act (Public Law 101-5084; TN6607) and the Resource Conservation and Recovery Act of 1976, as amended (Public Law 94-580; TN1281).

The Resource Conservation and Recovery Act governs the disposal of solid waste. VDEQ, the Virginia Waste Management Board, and the EPA regulate solid and hazardous waste in Virginia. As described in Section 2.1.5, "Nonradioactive Waste Management System," North Anna has a nonradioactive waste management program to handle nonradioactive waste in accordance with Federal, State, and corporate regulations and procedures. North Anna maintains a waste minimization program that uses material control, process control, waste management, recycling, and feedback to reduce waste.

The North Anna SWPPP identifies potential sources of pollution that may affect the quality of stormwater discharges from permitted outfalls. The SWPPP also describes BMPs for reducing pollutants in stormwater discharges and assuring compliance with the site's NPDES permit.

North Anna also has an environmental management system (VEPCO 2020-TN8099). Procedures are in place to monitor areas within the site that have the potential to discharge oil into or upon navigable waters, in accordance with the regulations in 40 CFR Part 112, "Oil Pollution Prevention" (TN1041). The Pollution Incident/Hazardous Substance Spill Procedure identifies and describes the procedures, materials, equipment, and facilities that Dominion uses to minimize the frequency and severity of oil spills at North Anna.

North Anna is subject to the EPA reporting requirements in 40 CFR Part 110 (TN8485), "Discharge of Oil," under Section 311(b)(4) of the Federal Water Pollution Control Act. Under these regulations, North Anna must report to the National Response Center any discharges of oil if the quantity may be harmful to the public health or welfare or to the environment. Based on the staff's review of Section E9.5.3.6 of the ER (VEPCO 2020-TN8099) and a review of records from 2013 through 2018, no spills reportable under 40 CFR Part 110 (TN8485), occurred. In addition, the applicant confirmed that no reportable spills have triggered this notification requirement since the ER was written (VEPCO 2021-TN8179).

North Anna is also subject to the reporting provisions of the State Water Control Law Section 62.1-44.34:19 (Code of Virginia, Title 62.1-TN8600), "Reporting of Discharge" (Article 11, "Discharge of Oil into Waters"). This reporting provision requires that any release of oil in a quantity of 25 gallons (95 liters) or greater to the environment be reported to VDEQ, the coordinator of emergency services of the locality that could reasonably be expected to be affected, and appropriate Federal authorities. Based on the staff's review of Section E9.5.12.6 of the ER (VEPCO 2020-TN8099), the only reportable spill occurring between 2013 and 2018 was an underground fuel oil leak from the leaking 2H B fuel oil feed line, which occurred in December 2016, for which the amount of fuel oil that leaked was not quantified. In addition, the applicant confirmed that there have been no reportable spills that would trigger this notification requirement since the ER was written (VEPCO 2021-TN8179).

3.13.3 Proposed Action

The following sections address the site-specific environmental impacts of North Anna SLR on the environmental issues identified in Table 3-1 that relate to waste management.

3.13.3.1 Low-Level Waste Storage and Disposal

At North Anna, low-level radioactive waste is stored temporarily onsite before being shipped offsite for treatment or disposal at licensed treatment and disposal facilities (NRC 2002-TN665). Annual quantities of low-level radioactive waste generated at North Anna would vary from year to year depending on the number of maintenance activities undertaken. Because of the comprehensive regulatory controls in place for management of radioactive waste, Dominion's compliance with these regulations, and Dominion's use of licensed treatment and disposal facilities, the impacts of radioactive waste are expected to be SMALL during the SLR term. There are no other operating nuclear power plants, fuel-cycle facilities, or radiological waste treatment and disposal facilities within a 50 mi (80 km) radius of North Anna. The NRC staff identified no information or situations that would result in different impacts for this issue for the SLR term at North Anna. Therefore, the NRC staff concludes that the environmental impacts from low-level waste storage and disposal due to continued nuclear plant operations at North Anna during the SLR term would be SMALL.

3.13.3.2 Onsite Storage of Spent Nuclear Fuel

As discussed in Section 2.1.4.4 "Radioactive Waste Storage", North Anna spent fuel is stored in a spent fuel pool and in an onsite independent spent fuel storage installation. The North Anna onsite ISFSI is licensed under the general license provided to power reactor licensees under 10 CFR 72.210, "General license issued." The NRC's regulations and its oversight of onsite spent fuel storage ensure that the increased volume in onsite storage from operation during the SLR term can be safely accommodated with little environmental effect. The ISFSI safely stores spent fuel onsite in licensed and approved dry cask storage containers.

This issue was also considered for NRC staff's review of North Anna's initial license renewal, and no new and significant information was found at that time (NRC 2002-TN8296). The NRC staff identified no information or situations that would result in different impacts for this issue for the SLR term at North Anna. Therefore, the NRC staff concludes that the environmental impacts from onsite storage of spent nuclear fuel due to continued nuclear plant operations at North Anna during the SLR term would be SMALL.

3.13.3.3 Offsite Radiological Impacts of Spent Nuclear Fuel and High-Level Waste Disposal

As related to the issue of offsite radiological impacts of spent nuclear fuel and high-level waste disposal, a history of the NRC's Waste Confidence activities is provided in NUREG-2157, "Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel," Section 1.1, “History of Waste Confidence” (NRC 2014-TN4117). The management and ultimate disposition of spent nuclear fuel is limited to the findings codified in the September 19, 2014, Continued Storage of Spent Nuclear Fuel, Final Rule (79 FR 56238-TN4104) and associated NUREG-2157. The ultimate disposal of spent fuel in a potential future geologic repository is a separate and independent licensing action that is outside the regulatory scope of this site-specific review. Per 10 CFR Part 51 (TN250) Subpart A, the Commission concludes that the impacts presented in NUREG-2157 would not be sufficiently large to require the NEPA conclusion, for any nuclear power plant, that the option of extended operation under 10 CFR Part 54 (TN4878) should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent nuclear fuel and high-level waste disposal, this issue is considered generic to all nuclear power plants and does not warrant a site-specific analysis for the continued nuclear power plant operations at North Anna during the SLR term.

3.13.3.4 Mixed-Waste Storage and Disposal

Mixed waste, regulated under RCRA of 1976, as amended (RCRA; Public Law 94-580; TN1281) and the AEA of 1954, as amended (42 U.S.C. § 2011 et seq.; TN663), is waste that is both radioactive and hazardous (EPA 2019-TN6956). Mixed waste is subject to dual regulation: by the EPA or an authorized State for its hazardous component and by the NRC or an agreement state for its radioactivity. Similar to hazardous waste, mixed waste is generally accumulated onsite in designated areas as authorized under RCRA then shipped offsite for treatment as appropriate and for disposal. Occupational exposures and any releases from onsite treatment of these and any other types of wastes are considered when evaluating compliance with the applicable Federal standards and regulations: for example, 10 CFR Part 20-TN283, 40 CFR Part 190-TN739, and 10 CFR Part 50, Appendix I-TN249. Because of the comprehensive regulatory controls in place for the management of mixed waste, Dominion’s compliance with these regulations and Dominion’s use of licensed treatment and disposal facilities, the impacts of mixed waste are expected to be SMALL during the SLR term. The NRC staff identified no information or situations that would result in different impacts for this issue for the SLR term at North Anna. Therefore, the NRC staff concludes that the radiological and nonradiological environmental impacts from mixed waste storage and disposal due to continued nuclear plant operations at North Anna during the SLR term would be SMALL.

3.13.3.5 Nonradioactive Waste Storage and Disposal

Like any other industrial facility, nuclear power plants generate wastes that are not contaminated with either radionuclides or hazardous chemicals. North Anna has a nonradioactive waste management system to handle its nonradioactive hazardous and nonhazardous wastes. The waste is managed in accordance with Dominion’s procedures. Waste minimization and pollution prevention are important elements of operations at all nuclear power plants. Licensees are required to consider pollution prevention measures as dictated by the Pollution Prevention Act (Public Law 101-508; TN6607) and the Resource Conservation and Recovery Act of 1976, as amended (Public Law 94-580; TN1281). In addition, as discussed in Section 2.1.5, North Anna has a nonradioactive waste management program to handle nonradioactive waste in accordance with Federal, State, and corporate regulations and procedures. North Anna will continue to store and dispose of nonradioactive hazardous and nonhazardous waste in accordance with the EPA, State, and local regulations in permitted disposal facilities. With respect to unplanned, non-radiological releases, Dominion reported no accidental spills or similar releases of nonradioactive substances, including petroleum products, at North Anna over the period of 2017-2021, nor any associated notices of violation issued to Dominion for such releases (VEPCO 2021-TN8179, VEPCO 2022-TN8270). The NRC staff’s review of available information and regulatory databases found no documented instances of accidental spills of chemical or petroleum products to groundwater that resulted in a regulatory action over the period of 2017–2021. Because of the comprehensive regulatory controls in place for the management of nonradioactive waste and Dominion's compliance with these regulations, the impacts of nonradioactive waste are expected to be SMALL during the SLR term. The NRC staff identified no information or situations that would result in different impacts for this issue for the SLR term at North Anna. Therefore, the NRC staff concludes that the environmental impacts from nonradioactive waste storage and disposal due to continued nuclear plant operations at North Anna during the SLR term would be SMALL.

3.13.4 No-Action Alternative

Under the no-action alternative, North Anna would cease operation at the end of the term of the current renewed facility operating licenses or sooner and enter decommissioning. After entering decommissioning, the nuclear power plant would generate less spent nuclear fuel, emit less gaseous and liquid radioactive effluents into the environment, and generate less low-level radioactive and nonradioactive wastes. In addition, following shutdown, the variety of potential accidents at the nuclear power plant (radiological and industrial) would be reduced to a limited set associated with shutdown events and fuel handling and storage. Therefore, as radioactive emissions to the environment decrease, and the likelihood and variety of accidents decrease following shutdown and decommissioning, the NRC staff concludes that impacts resulting from waste management from implementation of the no-action alternative would be SMALL.

3.13.5 Replacement Power Alternatives: Common Impacts

Impacts from waste management common to all analyzed replacement power alternatives would be from construction-related nonradiological debris generated during construction activities. This waste would be recycled or disposed of in approved landfills.

3.13.6 New Nuclear (Small Modular Reactor) Alternative

Impacts from the waste generated during the construction of the new nuclear alternative would include those identified in the previous paragraph, Section 3.13.5, as common to all replacement power alternatives.

During normal nuclear power plant operations, routine nuclear power plant maintenance and cleaning activities would generate radioactive low-level waste, spent nuclear fuel, high-level waste, and nonradioactive waste. Sections 2.1.4 and 2.1.5 of this EIS discuss radioactive and nonradioactive waste management at North Anna. As discussed in Section 2.3.2.1, "New Nuclear Alternative (Small Modular Reactor)", SMRs, in general, are LWRs that use water for cooling and enriched uranium for fuel in the same manner as conventional, large LWRs currently operating in the United States. Small modular reactor designs assumed in this alternative would use the same type of fuel (i.e., form of the fuel, enrichment, burnup, and fuel cladding) as large LWR nuclear power plants, and as such, all wastes generated would be similar to those generated at North Anna. The NRC does not expect the generation and management of solid radioactive and nonradioactive waste during the SLR term to result in significant environmental impacts. Based on this information, the NRC staff concludes that the waste impacts would be SMALL for the new nuclear alternative.

3.13.7 Combination Alternative (Solar, Offshore Wind, Small Modular Reactor, and Demand-Side Management)

Impacts from the waste generated during construction of replacement power alternatives would include those identified in Section 3.13.5 as common to all replacement power alternatives.

The construction of the solar photovoltaic facilities would create sanitary and industrial waste, although it would be of smaller quantity, compared to the SMR. This waste could be recycled or shipped to an offsite waste disposal facility. All the waste would be handled in accordance with appropriate VDEQ regulations. Impacts on waste management resulting from the construction and operation of the solar photovoltaic facilities of the combination alternative would be minimal, and of a smaller quantity, compared to the SMR. In summary, the waste management impacts resulting from the construction and operation of the solar photovoltaic facilities would be SMALL.

During construction of offshore wind facilities as part of the combination alternative, waste materials or the accidental release of fuels are expected to be negligible because of the very limited amount of vessel traffic and construction activity that might occur with construction, installation, operation, and decommissioning of offshore turbine generators. Therefore, the waste management impacts would be SMALL.

Waste generation associated with construction and operation of the new nuclear component of the combination alternative would be similar to, but less than, those associated with the new nuclear alternative discussed in Section 3.13.6. This is because the SMR portion of this combination alternative would entail construction and operation of a single unit, a 400-MWe nuclear power plant.

For the demand-side management component, there may be an increase in wastes generated during installation or implementation of energy conservation measures, such as appropriate disposal of old appliances, installation of control devices, and building modifications. New and existing recycling programs would help minimize the amount of generated waste. Impacts from the demand-side management portion of this alternative would be SMALL.

Overall, the NRC staff concludes that waste impacts for the combination alternative would be SMALL.

3.14 Impacts Common to All Alternatives

This section describes the impacts that the NRC considers common to all alternatives discussed in this EIS, including the proposed action and replacement power alternatives. In addition, the following sections discuss termination of operations, the decommissioning of a nuclear power plant and potential replacement power facilities, and GHG emissions.

3.14.1 Fuel Cycle

This section describes the environmental impacts associated with the fuel cycles of both the proposed action and all replacement power alternatives that are analyzed in detail in this EIS.

3.14.1.1 Uranium Fuel Cycle

The uranium fuel cycle includes uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials, and management of low-level and high-level wastes related to uranium fuel cycle activities. The NRC evaluated the environmental impacts of operating uranium fuel cycle facilities, not including nuclear power plants, in two NRC publications: (1) WASH-1248, "Environmental Survey of the Uranium Fuel Cycle" (AEC 1974-TN23), and (2) (NUREG-0116 (TN292), "Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle" (NRC 1976-TN292). More recently, facilities for managing the back end of the uranium fuel cycle were considered in NUREG-2157 (NRC 2014-TN4117). As evaluated in NUREG-2157, the NRC reaffirmed in 2014 that geological disposal remains technically feasible and that acceptable sites can be identified.

The impacts associated with uranium mining, milling, and the transportation of radioactive materials among facilities, including the transportation of wastes to disposal facilities, were incorporated into the NRC's regulations at 10 CFR 51.51(b)(TN250), Table S-3, "Table of Uranium Fuel Cycle Environmental Data (Normalized to model LWR annual fuel requirement (WASH-1248) or reference reactor year (NUREG-0116 -TN292)." Specific categories of natural resource use included in Table S-3 include land use; water consumption and thermal effluents; radioactive releases; burial of transuranic waste, high-level waste, and low-level waste; and radiation doses from transportation and occupational exposures. 10 CFR 51.51(a) states that ERs related to the construction of nuclear plants shall include Table S-3 (TN250).

The environmental impacts associated with transporting fresh fuel to one model LWR and with transporting spent fuel and radioactive waste (low-level waste and mixed waste) from that LWR are provided in 10 CFR 51.52(c) (TN250), Table S-4, "Environmental Impact of Transportation of Fuel and Waste To and From One Light-Water-Cooled Nuclear Power Reactor." 10 CFR 51.52, "Environmental effects of transportation of fuel and waste—Table S-4," requires the consideration of Table S-4 in ERs related to the construction of nuclear plants (TN250).

Nuclear fuel is needed for the operation of nuclear power plants during the SLR term in the same way that it is needed during the initial license term. Therefore, the factors that affect the data presented in Tables S-3 and S-4 do not change whether a nuclear power plant is operating under its initial license or a subsequent renewed license. The following sections address the site-specific environmental impacts of North Anna SLR on four environmental issues related to the uranium fuel cycle.

<u>Offsite Radiological Impacts—Individual Impacts from Other Than the Disposal of Spent Fuel and High-Level Waste</u>

The primary indicators for offsite radiological impacts on individuals who live near uranium fuel cycle facilities are the concentrations of radionuclides in the effluents from the fuel cycle facilities and the radiological doses received by an a maximally exposed individual on the site boundary or at some location away from the site boundary. The basis for establishing the significance of individual effects is the comparison of the releases in the effluents and the maximum exposure doses with the permissible levels in applicable regulations. The analyses performed by the NRC in the preparation of Table S-3 (10 CFR Part 51-TN250) indicate that if the facilities operate under a valid license issued by either the NRC or an Agreement State, the individual effects will meet the applicable regulations. Based on these considerations, the NRC has concluded that the impacts on individuals from radioactive gaseous and liquid releases during the SLR term would remain at or below the NRC's regulatory limits. Efforts needed to keep releases and doses at ALARA levels will continue to apply to fuel cycle related activities. The NRC staff identified no information or situations that would result in different impacts for this issue for the SLR term at North Anna. Therefore, the NRC staff concludes that offsite radiological impacts of the uranium fuel cycle (individual effects from sources other than the disposal of spent fuel and high-level waste) due to continued nuclear plant operations at North Anna during the SLR term would be SMALL.

Offsite Radiological Impacts—Collective Impacts from Other Than the Disposal of Spent Fuel and High-Level Waste

The focus of this issue is the collective radiological doses to and health impacts on the public resulting from uranium fuel cycle facilities over the license renewal term. The radiological doses received by the public are calculated based on releases from the facilities to the environment, as provided in Table S-3 (TN250). These estimates were provided in the 1996 GEIS for the gaseous and liquid releases listed in Table S-3 as well as for radon-222 and technetium-99 releases (Rn-222 and Tc-99), which are not listed in Table S-3. The population dose commitments were normalized for each year of operation of the model 1,000 MWe LWR (reference reactor year).

Based on the analyses provided in the 1996 LR GEIS, the estimated involuntary 100-year dose commitment to the U.S. population resulting from the radioactive gaseous releases from uranium fuel cycle facilities (excluding the reactors and releases of Rn-222 and Tc-99) was estimated to be 400 person-rem (4 person-Sv) per reference reactor year. Similarly, the environmental dose commitment to the U.S. population from the liquid releases was estimated to be 200 person-rem (2 person-Sv) per reference reactor year. As a result, the total estimated involuntary 100-year dose commitment to the U.S. population from radioactive gaseous and liquid releases listed in Table S-3 was given as 600 person-rem (6 person-Sv) per reference reactor year (see Section 6.2.2 of the 1996 LR GEIS-TN288).

The doses received by most members of the public would be so small that they would be indistinguishable from the variations in natural background radiation. There are no regulatory limits applicable to collective doses to the public from fuel cycle facilities. All regulatory limits are based on individual doses. All fuel cycle facilities are designed and operated to meet the applicable regulatory limits.

Despite the lack of definitive data, some judgment as to the regulatory NEPA implications of these matters should be made and it makes no sense to repeat the same judgment in every case. The Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any nuclear power plant, that the option of extended operation under 10 CFR Part 54-TN4878 should be eliminated. Accordingly, the Commission has not assigned a single level of significance for the collective effects of the fuel cycle. The NRC staff identified no information or situations that would result in different impacts for this issue for the SLR term at North Anna. Therefore, the NRC staff concludes that offsite radiological impacts of the uranium fuel cycle (collective impacts from sources other than the disposal of spent fuel and high-level waste) due to continued nuclear power plant operations at North Anna during the SLR term would not be sufficiently large to require the NEPA conclusion that the option of North Anna SLR should be eliminated.

Nonradiological Impacts of the Uranium Fuel Cycle

Nonradiological impacts associated with the uranium fuel cycle facilities as they relate to license renewal are provided in Table S-3 (TN250). The significance of the environmental impacts associated with land use, water use, fossil fuel use, and chemical effluents were evaluated in the 1996 LR GEIS based on several relative comparisons. The land requirements were compared to those for a coal-fired power plant that could be built to replace the nuclear capacity if the operating license is not renewed. Water requirements for the uranium fuel cycle were compared to the annual requirements for a nuclear power plant. The amount of fossil fuel (coal and natural gas) consumed to produce electrical energy and process heat during the various phases of the uranium fuel cycle was compared to the amount of fossil fuel that would have been used if the electrical output from the nuclear plant were supplied by a coal-fired plant. Similarly, the gaseous effluents SO_2, NO_x, hydrocarbons, CO, and PM released because of the coal-fired electrical energy used in the uranium fuel cycle were compared with equivalent quantities of the same effluents that would be released from a 45-MWe coal-fired plant. It was noted that the impacts associated with uses of all resources would be SMALL. Any impacts associated with nonradiological liquid releases from the fuel cycle facilities would also be SMALL. The NRC staff identified no information or situations that would result in different impacts for this issue for the SLR term at North Anna. Therefore, the NRC staff concludes that the aggregate nonradiological impacts of the uranium fuel cycle due to continued nuclear power plant operations at North Anna during the SLR term would be SMALL.

Transportation

The environmental impacts associated with transportation of fuel and waste to and from one model nuclear power plant during the SLR term are addressed in Table S-4 (TN250). Table S-4 forms the basis for analysis of the environmental impacts of transportation of fuel and waste when evaluating applications for license renewal. The applicability of Table S-4 to license renewal applications was extensively studied in the 1996 LR GEIS (NRC 1996-TN288) and its Addendum 1 (NRC 1999-TN7671). The environmental impacts from the transportation of fuel and waste attributable to license renewal were found to be SMALL when they are within the parameters identified in 10 CFR 51.52 (TN250). The NRC staff identified no information or situations that would result in different impacts for this issue for the SLR term at North Anna and determined that North Anna is within the parameters identified in 10 CFR 51.52. Therefore, the NRC staff concludes that the transportation impacts of the uranium fuel cycle due to continued nuclear power plant operations at North Anna during the SLR term would be SMALL.

3.14.1.2 Replacement Nuclear Power Plant Fuel Cycles

New Nuclear Energy Alternatives

Uranium fuel cycle impacts for a nuclear power plant result from the initial extraction of fuel, transport of fuel to the facility, and management and ultimate disposal of spent fuel. The environmental impacts of the uranium fuel cycle are referenced above in Section 3.14.1.1.

Renewable Energy Alternatives

For renewable energy technologies that rely on the extraction of a fuel source (e.g., biomass), such alternatives may have fuel cycle impacts with some similarities to those associated with the uranium fuel cycle. Renewable energy technologies such as wind, solar, geothermal, and wave and ocean energy do not have a fuel cycle comparable to uranium fuel. This is because the natural resource exists (i.e., they are not consumed or irreversibly committed) regardless of any effort to use them for electricity production. Fuel cycle impacts for these renewable energy technologies cannot be determined.

3.14.2 Terminating Power Plant Operations and Decommissioning

This section describes the environmental impacts associated with the termination of operations and the decommissioning of a nuclear power plant and replacement power alternatives. All operating nuclear power plants will terminate operations and be decommissioned at some point after the end of their operating life or after a decision is made to cease operations.

The following sections address the site-specific environmental impacts of North Anna SLR on the environmental issues identified in Table 3-1 that relate to termination of nuclear power plant operations and decommissioning.

Termination of Plant Operations and Decommissioning

The decommissioning process begins when a licensee informs the NRC that it has permanently ceased reactor operations, defueled, and intends to decommission the nuclear plant. The licensee may also notify the NRC of the permanent cessation of reactor operations prior to the end of the license term. Consequently, most nuclear plant activities and systems dedicated to reactor operations would cease after reactor shutdown. The impacts from decommissioning a nuclear power plant are evaluated NUREG-0586, “Generic Environmental Impact Statement on Decommissioning Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors” (NRC 2002-TN7254). The NRC staff determined that license renewal would have a negligible effect on these impacts of terminating operations and decommissioning on all resources.

The NRC staff identified no information or situations that would result in different environmental impacts for this issue for the SLR term at North Anna. Therefore, the NRC staff concludes that the incremental environmental impacts of termination of plant operations and decommissioning due to continued nuclear power plant operations at North Anna during the SLR term would be SMALL (NRC 2002-TN7254).

New Nuclear Alternatives

The environmental impacts from the termination of nuclear power plant operations and decommissioning of a power generating facility are dependent on the facility’s decommissioning plan. Decommissioning plans generally outline the actions needed to restore the site to a condition equivalent in character and value to the site on which the facility was first constructed. General elements and requirements for a thermoelectric power plant decommissioning plan can include the removal of structures below grade, the removal of all accumulated waste materials, the removal of intake and discharge structures, and the cleanup and remediation of incidental spills and leaks at the facility.

Activities that are unique to the termination of operations and decommissioning of a nuclear power generating facility include the safe removal of the facility from service and the reduction of residual radioactivity to a level that permits release of the property under restricted conditions or unrestricted use and termination of the license.

Renewable Energy Alternatives

Termination of nuclear power plant operation and decommissioning for renewable energy facilities would generally be similar to the impacts discussed for new nuclear alternatives above. Decommissioning would involve the removal of facility components and operational wastes and residues to restore sites to a condition equivalent in character and value to the site on which the facility was first constructed.

3.14.3 Greenhouse Gas Emissions and Climate Change

The following sections discuss GHG emissions and climate change impacts. Section 3.14.3.1 evaluates GHG emissions associated with the operation of North Anna and replacement power alternatives. Section 3.14.3.2 discusses the observed changes in climate and potential future climate change during the SLR term, based on climate model simulations under future global GHG emissions scenarios.

3.14.3.1 Greenhouse Gas Emissions from the Proposed Project and Alternatives

Gases found in the Earth's atmosphere that trap heat and play a role in the Earth's climate are collectively termed GHGs. These GHGs include CO_2, methane (CH_4), nitrous oxide (N_2O), water vapor and fluorinated gases, such as hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. The Earth's climate responds to changes in concentrations of GHGs in the atmosphere because these gases affect the amount of energy absorbed and heat trapped by the atmosphere. Increasing concentrations of GHGs in the atmosphere generally increase the Earth's surface temperature. Atmospheric concentrations of CO_2, CH_4, and N_2O have significantly increased since 1750 (IPCC 2013-TN7434, IPCC 2021-TN7435). In 2019, atmospheric concentrations of CO_2 (measured at 410 parts per million) were higher than any time in at least 2 million years (IPCC 2023-TN8557). Long-lived GHGs—CO_2, CH_4, N_2O, and fluorinated gases—are well mixed throughout the Earth's atmosphere, and their impact on climate is long-lasting and cumulative in nature as a result of their long atmospheric lifetimes (EPA 2016-TN7561). Therefore, the extent and nature of climate change is not specific to where GHGs are emitted. Carbon dioxide is of primary concern for global climate change because it is the primary gas emitted as a result of human activities.

The sixth assessment synthesis report from the Intergovernmental Panel on Climate Change states that "it is unequivocal that human influence has warmed the atmosphere, ocean, and land" (IPCC 2023-TN8557). In 2019, global net GHG emissions were estimated to be 59±6.6 gigatons of CO_2 equivalents (CO_2eq), with the largest share in gross GHG emissions being CO_2 from fossil fuels combustion and industrial processes (IPCC 2023-TN8557). The EPA has determined that GHGs "may reasonably be anticipated both to endanger public health and to endanger public welfare" (74 FR 66496-TN245).

Proposed Action

The operation of North Anna results in both direct and indirect GHG emissions. Dominion has calculated direct (i.e., stationary and portable combustion sources) and indirect (i.e., workforce commuting). Fluorinated gas emissions from refrigerant sources and from electrical transmission and distribution systems can result from leakage, servicing, repair, or disposal of sources. Dominion uses sulfur hexafluoride for electrical breaker cooling. In addition to being GHGs, chlorofluorocarbons and hydrochlorofluorocarbons are ozone-depleting substances that are regulated by the CAA (42 U.S.C. 7401 et seq.; Clean Air Act-TN1141) under Title VI, "Stratospheric Ozone Protection." Dominion maintains a program to manage stationary refrigeration appliances at North Anna to recycle, recapture, and reduce emissions of ozone-depleting substances. North Anna's annual GHG emissions are reported in Table 3-32. Dominion does not maintain an inventory of GHG emissions resulting from visitor and delivery vehicles (VEPCO 2020-TN8099). Therefore, Table 3-32 below does not account for GHG emissions from visitor and delivery vehicles.

Table 3-32 Annual Greenhouse Gas Emissions from Operation at North Anna

Year	Onsite Sources[(a)] (in tons)	Workforce Commuting[(b)] (in tons)	Total Carbon Dioxide Equivalents (CO_2eq) (in tons)
2017	1,010	4,485	5,495
2018	1,140	4,485	5,625
2019	1,090	4,485	5,575
2020	1,020	4,485	5,505
2021	930	4,485	5,415
2022	700	4,485	5,185

Note: GHG emissions are reported in metric tons and converted to short tons. All reported values are rounded. To convert tons per year, multiply by 0.90718. Expressed in carbon dioxide equivalents (CO_{2eq}), a metric used to compare the emissions of GHGs based on their GWP. The GWP is a measure used to compare how much heat a GHG traps in the atmosphere. The GWP is the total energy that a gas absorbs over a period of time compared to CO_2. CO_{2eq} is obtained by multiplying the amount of the GHG by the associated GWP. For example, the GWP of methane is 21; therefore, 1 ton of methane emission is equivalent to 21 tons of CO_2 emissions.

(a) Onsite sources include the North Anna's combustion sources (blackout diesel generator and four emergency generators), CO_2 added to the fire suppression system, sulfur hexafluoride used for electrical breaker cooling, and hydrofluorocarbon refrigerant used for equipment onsite.

(b) Emissions consider North Anna permanent full-time workers (870 passenger vehicles per day based on a 3.6 percent carpool rate for 903 employees) and does not include additional contractor workers during refueling outages. Refueling outages occur on a staggered, 18-month schedule and last approximately 30 days per unit.

Source: VEPCO 2023-TN8534

No-Action Alternative

Under the no-action alternative, the NRC would not issue subsequent renewed licenses, and North Anna would shut down on or before the expiration of the current renewed licenses. At some point, all nuclear power plants will terminate operations and undergo decommissioning. The decommissioning GEIS (NUREG-0586, NRC 2002-TN665) considers the environmental impacts from decommissioning. Therefore, the scope of impacts considered under the no-action alternative includes the immediate impacts resulting from activities at North Anna that would occur between nuclear power plant shutdown and the beginning of decommissioning (i.e., activities and actions necessary to cease operation of North Anna). Facility operations would terminate at or before the expiration of the current renewed licenses. When the facility stops operating, a reduction in GHG emissions from activities related to nuclear power plant operation, such as the use of diesel generators and employee vehicles, would occur. The NRC staff anticipates that GHG emissions for the no-action alternative would be less than those presented in Table 3-32.

Because the no-action alternative would result in a loss of power-generating capacity due to nuclear power plant shutdown, the sections below discuss GHG emissions associated with replacement baseload power generation for each replacement power alternative analyzed.

New Nuclear Alternative (Small Modular Reactor)

The LR GEIS (NUREG-1437) presents life-cycle GHG emissions associated with nuclear power generation. As presented in Tables 4.12-4 through 4.12-6 of the LR GEIS (NRC 2013-TN2654), life-cycle GHG emissions from nuclear power generation can range from 1 to 288 grams of carbon equivalent per kilowatt-hour (g Ceq/kWh). Nuclear power plants do not burn fossil fuels to generate electricity. Sources of GHG emissions from the new nuclear alternative would include stationary combustion sources such as emergency diesel generators, boilers, and pumps similar to existing sources at North Anna (see Section 3.3.2, "Air Quality," of this EIS). The NRC staff estimates that GHG emissions from a new nuclear alternative would be similar to those from North Anna.

Combination Alternative

For the combination alternative, GHGs would primarily be emitted from the new nuclear alternative component and offshore wind portion of this alternative. Sources of GHGs for the new nuclear portion are discussed above. Sources of GHGs for the offshore wind component would include diesel generators supporting meteorological data collection facilities. Emissions of GHGs for the combination alternative would be similar and comparable to those from North Anna.

Summary of Greenhouse Gas Emissions from the Proposed Action and Alternatives

The proposed action, the no-action alternative, new nuclear alternative, and combination alternative would have similar and comparable GHG emissions. If North Anna's generating capacity were to be replaced by either the new nuclear alternative or the combination alternative, there would be no significant increase or decrease in GHG emissions.

As discussed in Section 2.3.2 of this EIS, the Commonwealth of Virginia recently passed the VCEA (TN8532). This legislation mandates that electric generation in Virginia be 100 percent carbon-free by 2045; this would require the closure of all carbon-emitting power plants that generate electricity, including power plants that generate electricity using natural gas, unless a waiver has been sought by the utility and granted by the State, to allow the continued operation of such power plants. Further, the VCEA establishes yearly total electricity energy targets that must come from renewable sources. The NRC staff concludes that the proposed action, the new nuclear alternative, and the combination alternative appear to align with the goals of the VCEA.

3.14.3.2 Climate Change

Climate change is the decades or longer change in climate measurements (e.g., temperature and precipitation) that has been observed on a global, national, and regional level (IPCC 2007-TN7421; EPA 2016-TN7561; USGCRP 2014-TN3472). Climate change research indicates that the cause of the Earth's warming over the last 50 to 100 years is due to the buildup of GHGs in the atmosphere resulting from human activities IPCC 2013-TN7434, IPCC 2021-TN7435; IPCC 2023-TN8557; USGCRP 2014-TN3472, USGCRP 2017-TN5848, USGCRP 2018-TN5847).

Observed Trends in Climate Change Indicators

Global surface temperature has increased faster since 1970 than in any other 50-year period over at least the last 2,000 years (IPCC 2023-TN8557). On a global level, from 1901 to 2016, the average temperature has increased by 1.8°F (1.0°C) (USGCRP 2018-TN5847). Since 1901, precipitation has increased at an average rate of 0.04 in. (0.0.1 cm) per decade on a global level

(EPA 2021-TN8555). The U.S. Global Change Research Program (USGCRP) reports that from 1901 to 2016, average surface temperatures have increased by 1.8°F (1.0°C) across the contiguous United States (USGCRP 2018-TN5847). Since 1901, average annual precipitation has increased by 4 percent across the United States (USGCRP 2018-TN5847). Observed climate change indicators across the United States include increases in the frequency and intensity of heavy precipitation, earlier onset of spring snowmelt and runoff, rise of sea level and increased tidal flooding in coastal areas, an increased occurrence of heat waves, and a decrease in the occurrence of cold waves. Since the 1980s, data show an increase in the length of the frost-free season (i.e., the period between the last occurrence of 32°F (0°C) in the spring and first occurrence of 32°F (0°C) in the fall), across the contiguous United States. Over the period 1991 through 2011, the average frost-free season was 10 days longer (relative to the 1901 through 1960 time period) (USGCRP 2014-TN3472). Over just the past two decades, the number of high-temperature records observed in the United States has far exceeded the number of low-temperature records (USGCRP 2018-TN5847). Since the 1980s, the intensity, frequency, and duration of North Atlantic hurricanes have increased (USGCRP 2014-TN3472).

Climate change and its impacts can vary regionally, spatially, and seasonally, depending on local, regional, and global factors. Observed climate changes and impacts have not been uniform across the United States. Section 4.15.3.2, “Observed Trends in Climate Change Indicators,” of NUREG-1437, Supplement 6, Second Renewal (NRC 2020-TN7324), the SEIS for SLR of Surry Power Station, Units 1 and 2, describes in detail observed changes in average temperature and precipitation on a global level and across the United States and the Southeast region. Unlike Surry Power Station, North Anna is not located on a tidal river, and Lake Anna is not directly affected by sea level changes along the Atlantic coast. See “Climate Change Projections” below for a discussion of how climate change can impact surface water resources in the vicinity of North Anna. Therefore, with the exception of information related to sea level rise, the NRC staff incorporates the observed trends described in Section 4.15.3.2 of NUREG-1437, Supplement 6, Second Renewal by reference (NRC 2020-TN7324: 4.15.3.2, 4127-4-129), with key information summarized below.

The Southeast is one of the few places in the world where there has not been an overall increase in daily maximum temperatures since 1900 (NOAA 2013-TN7424); however, since the early 1960s, the Southeast has been warming at a similar rate as the rest of the United States and has been accompanied by an increase in the number of hot days with maximum temperatures above 95°F (35°C) in the daytime and above 75°F (23.9°C) in the nighttime (NOAA 2013-TN7424; USGCRP 2009-TN18, USGCRP 2014-TN3472, USGCRP 2018-TN5847: Fig. 19.1). Average annual precipitation data for the Southeast region does not exhibit an increasing or decreasing trend overall for the long-term period (1895–2011) (NOAA 2013-TN7433). Precipitation in the Southeast region varies considerably throughout the seasons, and average precipitation has generally increased in the fall and decreased in the summer (NOAA 2013-TN7433; USGCRP 2009-TN18).

The NRC staff used the NOAA Climate at a Glance tool to analyze temperature and precipitation trends for the period of 1895–2023 in the Eastern Piedmont Climate Division. A trend analysis shows that the average annual temperature has increased at a rate of 0.1°F (0.06°C) per decade, while average annual precipitation has increased at a rate of 0.29 in. (0.7 cm) per decade (NOAA 2023-TN8560).

Climate Change Projections

Future global GHG emission concentrations (emission scenarios) and climate models are commonly used to project possible climate change. Climate models indicate that, over the next few decades, temperature increases will continue due to current GHG emission concentrations in the atmosphere (USGCRP 2014-TN3472). This is because it takes time for Earth's climate system to respond to changes in GHG concentrations; if GHG concentrations were to stabilize at current levels, this would still result in at least an additional 1.1°F (0.6°C) of warming (USGCRP 2018-TN5847). Over the longer term, the magnitude of temperature increases and climate change effects will depend on future global GHG emissions (IPCC 2007-TN7421, IPCC 2013-TN7434; USGCRP 2009-TN18, USGCRP 2014-TN3472, USGCRP 2018-TN5847). Climate model simulations often use GHG emission scenarios to represent possible future social, economic, technological, and demographic development that, in turn, drive future emissions. Consequently, the GHG emission scenarios, their supporting assumptions, and the projections of possible climate change effects entail substantial uncertainty.

Section 4.15.3.2 of NUREG-1437, Supplement 6, Second Renewal (NRC 2020-TN7324), describes in detail annual mean temperature and precipitation projections for Virginia based on climate model simulations and future GHG scenarios. As discussed in NUREG-1437, Supplement 6, Second Renewal (NRC 2020-TN7324), the SEIS for SLR of Surry Power Station, Units 1 and 2, increases in temperature are projected to occur across the majority of the Southeast region under a low- and high-emissions scenario. With the exception of the information related to sea level rise, the NRC staff incorporates the discussion contained in Section 4.15.3.2, "Climate Change Projections," of NUREG-1437, Supplement 6, Second Renewal, into this EIS by reference (NRC 2020-TN7324: Section 4.15.3.2, 4-129–4-132), with key information summarized in this section. Climate model simulations suggest spatial differences in annual mean precipitation change across the Southeast, with some areas experiencing an increase and others a decrease in precipitation. For the period 2041–2070 (2055 midpoint), a 0 to 3-percent increase in annual mean precipitation is projected for both a low- and high-emission modeled scenario across the northern reaches of the Southeast region, encompassing Virginia. Increases are projected to occur in the winter, spring, and fall, with decreases during the summer (NOAA 2013-TN7424).

The effects of climate change on North Anna structures, systems, and components are outside the scope of the NRC staff's SLR environmental review. The environmental review documents the potential effects from continued nuclear power plant operation on the environment. Site-specific environmental conditions are considered when siting nuclear power plants. This includes the consideration of meteorological and hydrologic siting criteria as set forth in 10 CFR Part 100, "Reactor Site Criteria" (TN282). NRC regulations require that nuclear power plant structures, systems, and components important to safety be designed to withstand the effects of natural phenomena, such as flooding, without loss of capability to perform safety functions. Further, nuclear power plants are required to operate within technical safety specifications in accordance with the nuclear power plants' NRC operating license, including coping with natural phenomena hazards. The NRC conducts safety reviews before allowing licensees to make operational changes due to changing environmental conditions. Additionally, the NRC evaluates nuclear power plant operating conditions and physical infrastructure to ensure safe operation under the nuclear power plant's initial and renewed facility operating licenses through the NRC's Reactor Oversight Program. If new information about changing environmental conditions that threaten safe operating conditions or challenge compliance with the nuclear power plant's technical specifications becomes available, the NRC will evaluate the new information to determine if any safety-related changes are needed at licensed nuclear power plants.

Nonetheless, changes in climate could have broad implications for certain resource areas. As discussed below, the NRC staff considers the impacts of climate change on environmental resources that are incrementally affected by the proposed action.

Air Quality: Climate change can impact air quality as a result of changes in meteorological conditions. The formation, transport, dispersion, and deposition of air pollutants depend, in part, on weather conditions (IPCC 2007-TN7421). Ozone is particularly sensitive to climate change (IPCC 2007-TN7421). Ozone is formed by the chemical reaction of NO_x and VOCs in the presence of heat and sunlight. Sunlight, high temperatures, and air stagnation are favorable meteorological conditions for higher levels of ozone (IPCC 2007-TN7421; 74 FR 66496-TN245). The emission of ozone precursors also depends on temperature, wind, and solar radiation (IPCC 2007-TN7421). According to the EPA, both nitrogen oxide and biogenic VOC emissions are expected to be higher in a warmer climate (74 FR 66496-TN245). Although surface temperatures are expected to increase in the Southeast region of the United States (where North Anna is located), this may not necessarily result in an increase in ozone. While some climate models project seasonal, short-term increases of ozone concentrations during summer months in the Southeast (e.g., Wu et al. 2007-TN8566), others (e.g., Tao et al. 2007-TN8567; Nolte et al. 2018-TN8571; Meehl et al. 2018-TN8574) found differences in future changes in ozone for the Southeast with decreases in ozone concentrations under a low-emission modeled scenario, increases under a high-emission modeled scenario, or decreases in ozone on heat wave days. Among modeled studies of climate-related ozone changes, model simulations for the Southeast region have the least consensus. Therefore, the potential cumulative impact on air quality ozone levels in the vicinity of North Anna due to climate change is unknown.

Surface Water Resources: Elevated surface water temperatures can decrease the cooling efficiency of thermoelectric power generating facilities and nuclear power plant capacity. Therefore, as intake water temperatures warm, the volume of surface water needed for nuclear power plant cooling can increase (USGCRP 2014-TN3472). Nuclear power plants would have to account for any changes in water temperature in operational practices and procedures.

Since 1958, heavy precipitation (i.e., the amount of annual precipitation falling in the heaviest 1 percent of events) has increased by an average of 27 percent across the Southeast (USGCRP 2018-TN5847: Fig. 2.6). Observed increases in heavy precipitation events are projected to continue across the Southeast, including Virginia. Increases in annual precipitation and heavy precipitation events can result in greater runoff from the land while increasing the potential for riverine flooding. In turn, these changes can result in the transport of a higher sediment load and other contaminants to surface waters with potential degradation of ambient water quality.

3.15 Cumulative Effects of the Proposed Action

Actions considered in the cumulative effects (impacts) analysis include the proposed SLR action when added to the environmental effects from past, present, and reasonably foreseeable future actions. The analysis considers all actions, however minor, because the effects of individually minor actions may be significant when considered collectively over time. The goal of the cumulative effects analysis is to identify potentially significant impacts. The environmental effects of the proposed SLR action when combined with the effects of other actions could result in a cumulative impact.

The cumulative effects or impacts analysis only considers resources and environmental conditions that could be affected by the proposed license renewal action, including the effects of continued reactor operations during the SLR term and any refurbishment activities at a nuclear power plant. In order for there to be a cumulative effect, the proposed action (SLR) must have an incremental new, additive, or increased physical impact on the resource or environmental condition beyond what is already occurring.

For the purposes of this analysis, past and present actions include all actions that have occurred since the commencement of North Anna reactor operations up to the submittal of the SLR request. Older actions are accounted for in baseline assessments presented in the affected environment discussions in Sections 3.2 through 3.13. The time frame for the consideration of reasonably foreseeable future actions is the 20-year SLR term. Reasonably foreseeable future actions include current and ongoing planned activities through the end of the period of extended operation.

The incremental effects of the proposed action (SLR) when added to the effects from past, present, and reasonably foreseeable future actions and other actions result in the overall cumulative effect. A qualitative cumulative effects analysis is conducted in instances where the incremental effects of the proposed action (SLR) and past, present, and reasonably foreseeable future actions are uncertain or not well known.

Although Dominion stated in its ER that it has not decided whether to proceed with the construction and operation of North Anna Unit 3, it did consider Unit 3 to be a reasonably foreseeable action (VEPCO 2020-TN8099, VEPCO 2021-TN8179). Accordingly, the NRC considers North Anna Unit 3 to be a reasonably foreseeable future action in the cumulative effects analysis. Therefore, North Anna Unit 3 construction and operation impacts have been factored into the cumulative impacts analysis.

Chapter 7.0 of the North Anna Unit 3 combined license EIS (NUREG-1917) (NRC 2010-TN6) provides an analysis of cumulative impacts at the North Anna site resulting from the future effects of constructing and operating Unit 3 combined with the operational effects of North Anna Units 1 and 2. This information is incorporated here by reference (NRC 2010-TN6: p. 7-1 through 7-8).

The following sections discuss the cumulative effects on the environmental near North Anna—when the incremental environmental effects of the proposed SLR action are compounded by the effects of past, present, and reasonably foreseeable future actions. For the most part, environmental conditions near North Anna are not expected to change appreciably during the SLR term beyond what is already being experienced. Consequently, no cumulative impacts analysis was performed for the following resource areas: land use, noise, geology and soils, terrestrial resources, aquatic resources, and historic and cultural resources.

Appendix E, "Projects and Actions Considered in the Cumulative Impacts Analysis," describes other actions, including new and continuing activities and specific projects that were identified during this environmental review and considered in the analysis of potential cumulative impacts.

3.15.1 Air Quality

The ROI in the cumulative air quality analysis consists of Louisa and Spotsylvania counties, because air quality designations in Virginia are made at the county level. North Anna is located primarily in Louisa County, with a portion of the site extending into neighboring Spotsylvania County, Virginia. Dominion has not proposed any refurbishment-related activities during the SLR term. As a result, air emissions from the nuclear power plant during the SLR term would be similar to those presented in Section 3.3, "Meteorology, Air Quality, and Noise." Therefore, there would be no cumulative effect from the proposed action caused by continued operations at North Anna in the SLR term beyond what is already being experienced.

Appendix E identifies present and reasonably foreseeable projects that could contribute to future air quality in Louisa and Spotsylvania counties. Current air emission sources operating in Louisa and Spotsylvania counties have not resulted in long-term NAAQS violations, given the designated in attainment status for all criteria pollutants. Consequently, cumulative changes to air quality in Louisa and Spotsylvania counties would be the result of future projects and actions that change present-day emissions within the counties, unrelated to the proposed action (SLR).

Development and construction activities identified in Appendix E could increase air emissions during their respective construction periods, but those air emissions would be temporary and localized. Air emissions associated with the operation of future solar photovoltaic facilities would be negligible because no fossil fuels would be directly burned to generate electricity. However, future operation of facilities can result in an increase in vehicular traffic and in overall long-term air emissions that contribute to cumulative air quality impacts. Any entity establishing new stationary sources of emissions in the ROI would be required to apply for an air permit from VDEQ and would also be required to operate in accordance with applicable Federal, State, and local regulatory requirements.

3.15.2 Water Resources

3.15.2.1 Surface Water Resources

The description of the affected environment in Section 3.5.7.1, "Surface Water Resources," serves as the baseline for the cumulative impacts assessment for surface water resources. North Anna withdraws cooling water directly from Lake Anna and discharges return flows and comingled effluents to the dedicated WHTF and ultimately to the reservoir. As such, this cumulative impact review focuses on those projects and activities that would withdraw water from, or discharge effluents to Lake Anna and its tributaries (see Figure 2-1).

Water Use and Water Quality Considerations

The cumulative impacts on surface water resources at North Anna are discussed in Section 7.3, "Water Use and Quality," of the NRC's SEIS for the proposed Unit 3 COL at North Anna (NUREG-1917) (NRC 2010-TN6). In that analysis, the combined impacts on Lake Anna's hydrology and water quality associated with existing Units 1 and 2, along with the incremental impacts of constructing and operating North Anna Unit 3. The NRC reviewed Dominion's water budget model of Lake Anna and proposed Unit 3 operational parameters and their effect on consumptive water use in NUREG-1917, and concluded the cumulative impacts on water use, including the construction and operation of Unit 3, would remain SMALL except during drought periods, when the impacts could be MODERATE. The cumulative impacts analysis in Section 7.3 of NUREG-1917 is incorporated by reference (NRC 2010-TN6: Section 7.3, p. 7-2–7-4), to present an analysis of cumulative impacts if Dominion were to construct and operate Unit 3 during the SLR period of extended operation.

Lake Anna was created to provide a source of cooling water for North Anna. As discussed in Section 3.5.1.2, with the exception of a small fraction of water lost to evaporation, surface water withdrawn by North Anna is returned to Lake Anna. Dominion has not proposed to increase North Anna Unit 1 and 2 surface water withdrawals or consumptive water use during the SLR term. In addition, as referenced in Section 3.5.1.1, Dominion has a Virginia water protection permit (number 10-2001) for operation of proposed Unit 3. This permit, in conjunction with the release schedule for the North Anna Dam included in Dominion's VPDES permit for Units 1 and 2 (VEPCO 2020-TN8383), will help to ensure that minimum instream flows are maintained in the North Anna River to minimize water use conflicts and to safeguard designated uses. No new or proposed projects were identified (see Appendix E, Table E-1) that have the potential to substantially impact surface water withdrawals or consumptive water use in the Lake Anna watershed. The resolution of any future conflicts over water availability would fall within the regulatory authority of the Commonwealth of Virginia.

Section 7.3 of NUREG-1917 (NRC 2010-TN6), evaluates the potential cumulative impacts on water quality associated with the operation of North Anna Unit 3 combined with existing Units 1 and 2. The presence of two pollutants (copper and tributyltin) and the potential for the pollutants to be concentrated by the operation of proposed Unit 3's cooling system were considered. Based on this analysis, the cumulative water-quality impacts associated with the North Anna Unit 3 would remain SMALL, as all effluent discharges would be regulated under the VPDES permit program. The analysis in Section 7.3 of NUREG-1917 is incorporated by reference (NRC 2010-TN6: Section 7.3, p. 7-2–7-4), to address the cumulative impacts on water resources if Dominion were to decide to construct and operate North Anna Unit 3 during the SLR period of extended operation.

Appendix E, Table E-1 lists a number of ongoing and reasonably foreseeable future actions that could impact surface water quality in affected watersheds. Specific to the Lake Anna region, the primary impact driver is likely to be continued residential and mixed-use development.

Future development could also result in water quality degradation if those projects increase sediment loading and the discharge of other pollutants to nearby surface water bodies. On an individual facility basis, State-issued permits (i.e., the VPDES in Virginia) under CWA Section 402 set limits on wastewater, stormwater associated with construction and industrial activity, and other point source discharges. As previously discussed, CWA Section 303(d) requires states to identify all "impaired" waters for which effluent limitations and pollution control activities are not sufficient to attain water quality standards and to establish total maximum daily loads to ensure future compliance with water quality standards. Consequently, a substantial regulatory framework exists to address current and potential future sources of water quality degradation within the watershed of Lake Anna with respect to potential cumulative impacts on surface water quality. Based on the hydrologic setting, compliance with applicable water use and water quality permitting and associated permit conditions, and adherence to BMPs, the proposed action would have no cumulative effect on surface water resources beyond what is already being experienced.

3.15.2.2 Groundwater Resources

Section 3.5.2, "Groundwater Resources," describes regional groundwater supply systems. In the North Anna region, over the period of license renewal, the groundwater within the aquifer should continue to be affected by human activities and natural processes. Surrounding aquifer resources may continue to be subject to depletion and water quality degradation; however, the hydraulically isolated nature of the North Anna site groundwater aquifer with respect to the surrounding area precludes impacts on the surrounding region and users. In addition, the North Anna site has approved waste management and spill prevention practices and stormwater BMPs in place to prevent or minimize surface source releases from migrating to the groundwater flow system. Therefore, continued pumping of groundwater at the North Anna site during the SLR term is anticipated to have a negligible impact on groundwater contamination, groundwater use conflicts, and groundwater degradation impacts.

If North Anna Unit 3 is constructed and operated, up to five additional domestic wells would be developed for Unit 3 construction and operation (NRC 2010-TN6) under the purview of VDEQ and VDH permitting requirements. Withdrawals related to construction dewatering for Unit 3 foundations and basemats would cause aquifer drawdowns; however, drawdown due to well water withdrawals during construction and operation would be mitigated by the hydraulic boundaries of Lake Anna and the discharge canal.

Based on the review of Dominion's annual radioactive effluent release report data (VEPCO, 2018-TN8391, 2019-TN8392, 2020-TN8393, 2021-TN8394, 2022-TN8476), the North Anna site monitoring program is consistent with the groundwater protection procedures as described in ER Section E3.6.2.4 (VEPCO 2020-TN8099). During the past 5 years, the monitoring well network has detected tritium in groundwater, while no nuclear power plant-related gamma isotopes or residual radionuclides have been detected. As described in Section 3.5.2.3, GWP-18 tritium concentrations were indicative of surface water leaking into the pipe tunnel and subsequent leaching of tritium from the concrete of the tunnel to the ground. After excess water was removed from the tunnel, GWP-18 concentrations returned to historical threshold values. Pipe tunnel surface water ingress points were sealed during 2020 and the tunnel remains dry to preclude leaching of residual tritium in tunnel concrete to groundwater (VEPCO 2021-TN8268).

Groundwater well permitting and withdrawals are within the purview of VDEQ and VDH permitting requirements. Based on the hydrogeologic setting, compliance with groundwater permitting, adherence to the groundwater protection initiative (NRC 2007-TN8483), the proposed action would have no cumulative effect beyond what is already being experienced.

3.15.3 Socioeconomics

As discussed in Section 3.10.7, continued operation of North Anna during the SLR term would have no impact on socioeconomic conditions in the region beyond what is already being experienced. Dominion has no planned activities at North Anna beyond continued reactor operations and maintenance.

As summarized in Section 7.6 of NUREG-1917 (NRC 2010-TN6), the cumulative socioeconomic impacts from constructing and operating North Anna Unit 3 could range from MODERATE to LARGE. As discussed in Section 4.5 (NUREG-1917, NRC 2010-TN6), regional transportation and recreational use of Lake Anna, area housing, and school enrollment could experience MODERATE construction impacts. These impacts would be temporary and limited to peak construction periods. As discussed in NUREG-1917 (NRC 2010-TN6), Section 5.5, socioeconomic impacts during Unit 3 operations could also have MODERATE to LARGE impacts on the regional economy and tax revenue (NRC 2010-TN6: Sections 4.5, 5.5, 7.6, p. 4–13–4-20, p. 5-17–5-28, p. 7–6). The socioeconomic impact analyses in NUREG-1917 is incorporated into this EIS by reference (NRC 2010-TN6).

Because Dominion has no plans to hire additional workers during the SLR term, overall expenditures and employment levels at North Anna would remain unchanged with no new or increased demand for housing and public services. Therefore, the only contributory effects would come from reasonably foreseeable future planned operational activities at North Anna and other planned offsite activities, unrelated to the proposed action (SLR). When combined with past, present, and reasonably foreseeable future activities, the proposed action would have no new or increased cumulative effect beyond what is already being experienced.

3.15.4 Human Health

The NRC and the EPA have established radiological dose limits to protect the public and workers from both acute and long-term exposure to radiation and radioactive materials. These dose limits are specified in 10 CFR Part 20-TN283 and 40 CFR Part 190-TN739, “Environmental Radiation Protection Standards for Nuclear Power Operations.” As discussed in Section 3.11.6 et seq., “Human Health,” the impacts on human health from continued nuclear power plant operations during the SLR term would be SMALL.

For the purposes of this cumulative impacts analysis, the geographical area considered is the area within a 50-mi (80-km) radius of North Anna. There are no other nuclear power plants within this 50-mi (80-km) radius. However, that radius does overlap with the 50-mi (80-km) radius around the Surry Power Station and the Calvert Cliffs Nuclear Power Station, which are located approximately 86 mi (138 km) and 78 mi (125 km) from North Anna, respectively. Like North Anna, both nuclear power stations comply with all NRC and the EPA regulations on radiation and radioactive materials exposure. As discussed in Section 2.1.4.4, “Radioactive Waste Storage,” of this EIS, Dominion stores spent nuclear fuel from Units 1 and 2 in a storage pool and in an onsite ISFSI. Currently, the ISFSI consists of three separate spent fuel storage pads. Dominion stated in the ER that it has no current plans to add additional storage pads (VEPCO 2020-TN8099).

If Dominion were to construct and operate North Anna Unit 3 during the SLR period of extended operation, the operation of Unit 3 would result in additional radiological releases and dose impacts to workers and the public, in addition to the human health effects from operating Units 1 and 2. Operation of Unit 3 would generate additional spent fuel to be stored onsite, in addition to the spent fuel generated by Units 1 and 2. Section 5.9.2.3, “External Radiation Pathway“; Section 5.9.3, “Impacts to Members of the Public”; Section 5.9.4, “Occupational Doses to Workers”; and Section 6.1, “Fuel Cycle Impacts and Solid Waste Management” in NUREG-1917 (NRC 2010-TN6) describe the projected operational impacts of Unit 3. As summarized in NUREG-1917, Section 7.8 (NRC 2010-TN6), cumulative public and occupational doses from the operation of Units 1 and 2 combined with Unit 3 would be well below regulatory limits and standards. The radiological health, fuel cycle, and waste management impacts of Unit 3 operation combined with Units 1 and 2, would be SMALL (NRC 2010-TN6: Sections 5.9.2.3, 5.9.3, 5.9.4, 6.1, 7.8, p. 5-41–5-48, 6-1–6-3, 7-7). The human health impact analyses in NUREG-1917 is incorporated into this EIS by reference.

The EPA’s regulations, 40 CFR Part 190 (TN739), limit doses to members of the public from all sources in the nuclear fuel cycle, including nuclear power plants, fuel fabrication facilities, waste disposal facilities, and transportation of fuel and waste. As discussed in Section 2.1.4.5, “Radiological Environmental Monitoring Program,” Dominion has a REMP that measures radiation and radioactive materials in the environment from North Anna, its ISFSI, and all other sources. The radiological environmental monitoring results for the 5-year period from 2015 through 2019 showed no indication of an adverse trend in radioactivity levels in the environment from either North Anna or the ISFSI. The data showed that there was no measurable radiological impact on the environment from North Anna.

Based on this information, there would be no significant cumulative radiological effect on human health resulting from the proposed action (SLR), in combination with the cumulative effects from other sources. This conclusion is based on the review of radiological environmental monitoring program data, radioactive effluent release data, and worker dose data; the expectation that North Anna would continue to comply with Federal radiation protection standards during the period of extended operation; and the continued regulation of any future development or actions in the vicinity of North Anna by the NRC and the Commonwealth of Virginia.

3.15.5 Environmental Justice

This cumulative impact analysis evaluates the potential for disproportionate and adverse human health and environmental effects on minority and low-income populations that could result from past, present, and reasonably foreseeable future actions, including the continued operational effects of North Anna during the SLR term. Everyone living near North Anna, including minority and low-income populations, currently experiences its operational effects. The NRC addresses environmental justice by identifying the location of minority and low-income populations, determining whether there would be any potential human health or environmental effects, and whether any of the effects may be disproportionate and adverse to these populations.

Adverse health effects are measured in terms of the risk and rate of fatal or nonfatal adverse impacts on human health. Disproportionate and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population exceeds the risk or exposure rate for the general population or for another appropriate comparison group. Disproportionate environmental effects refer to impacts or risks of impacts in the natural or physical environment in a minority or low-income community that appreciably exceed the environmental impact on the larger community. Such effects may include biological, cultural, economic, or social impacts. Some of these potential effects have been identified in resource areas presented in preceding sections of this chapter. As previously discussed in this chapter, the SLR impacts for all resource areas (e.g., land, air, water, and human health) would be SMALL.

As discussed in Section 3.12, there would be no disproportionate and adverse human health and environmental effects on minority and low-income populations from the continued operation of North Anna during the SLR term. Because Dominion has no plans to hire additional workers during the SLR term (VEPCO 2020-TN8099), employment levels at North Anna would remain unchanged, and there would be no additional demand for housing or increase in traffic. Based on this information and the analysis of human health and environmental effects, it is not likely that there would be any disproportionate and adverse contributory effects on minority and low-income populations from the continued operation of North Anna during the SLR term beyond what is already being experienced. Therefore, the only contributory effects would come from reasonably foreseeable future planned activities at North Anna, and other reasonably foreseeable future offsite activities, unrelated to the proposed action (SLR).

The human health and environmental effects of constructing and operating North Anna Unit 3 were evaluated NUREG-1917 (NRC 2010-TN6) including cumulative effects. The analysis determined that there would be no disproportionate and adverse human health and environmental effects on minority and low-income populations from the construction and operation of North Anna Unit 3 alone or in combination with the operational effects of Units 1 and 2 (NRC 2010-TN6): Sections 4.7, 5.7, 7.6, p. 4-22–4-23, 5-29–5-31, 7-5–7-6). The environmental justice impact analyses in NUREG-1917 is incorporated into this EIS by reference.

When combined with past, present, and reasonably foreseeable future activities, the proposed action (SLR) would not likely cause disproportionate and adverse human health and environmental effects on minority and low-income populations near North Anna beyond effects already being experienced.

3.15.6 Waste Management and Pollution Prevention

This section considers the incremental waste management impacts of the SLR term when added to the contributory effects of past, present, and reasonably foreseeable future actions. As discussed in Section 3.13.3, "Proposed Action," the potential waste management impacts from continued operations at North Anna during the SLR term would be SMALL.

As discussed in Sections 2.1.4 and 2.1.5, Dominion maintains waste management programs for radioactive and nonradioactive waste generated at North Anna and is required to comply with Federal and State permits and other regulatory waste management requirements. All industrial facilities, including nuclear power plants and other facilities within a 30-mi (48-km) radius of North Anna, are also required to comply with appropriate NRC, EPA, and State requirements for the management of radioactive and nonradioactive waste. Current, waste management activities at North Anna would likely remain unchanged during the SLR term, and continued compliance with Federal and Commonwealth requirements for radioactive and nonradioactive waste is expected.

Cumulative waste impacts were addressed in NUREG-1917 (NRC 2010-TN6), Section 7.10, "Fuel Cycle, Transportation, and Decommissioning," and Unit 3 waste impacts were evaluated in Section 6.1, "Fuel Cycle Impacts and Solid Waste Management." During rector operations, uranium fuel cycle and solid waste management impacts of North Anna Unit 3, either alone or in combination with Units 1 and 2, would be SMALL (NRC 2010-TN6: Sections 6.1, 7.10, p. 6-1–6-3, 7-8). The waste management impact analyses in NUREG-1917 is incorporated into this EIS by reference.

Therefore, the proposed action, including the continued radioactive and nonradioactive waste generation during the SLR term, would have no cumulative effect beyond what is already being experienced. This is based on North Anna's continued compliance with Federal and Commonwealth of Virginia requirements for radioactive and nonradioactive waste management and the expected regulatory compliance of other waste producers in the area.

3.16 Resource Commitments Associated with the Proposed Action

This section describes the NRC staff's consideration of potentially unavoidable adverse environmental impacts that could result from implementation of the proposed action and alternatives; the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity; and the irreversible and irretrievable commitments of resources.

3.16.1 Unavoidable Adverse Environmental Impacts

Unavoidable adverse environmental impacts are impacts that would occur after implementation of all workable mitigation measures. Carrying out any of the replacement energy alternatives considered in this EIS, including the proposed action, would result in some unavoidable adverse environmental impacts.

Minor unavoidable adverse impacts on air quality would occur due to the emission and release of various chemical and radiological constituents from nuclear power plant operations. Nonradiological emissions resulting from nuclear power plant operations are expected to comply with Federal EPA and State emissions standards. Chemical and radiological emissions would not exceed the national emission standards for hazardous air pollutants.

During nuclear power plant operations, workers and members of the public would face unavoidable exposure to low levels of radiation as well as hazardous and toxic chemicals. Workers would be exposed to radiation and chemicals associated with routine nuclear power plant operations and the handling of nuclear fuel and waste material. Workers would have higher levels of exposure than members of the public, but doses would be administratively controlled and are not expected to exceed regulatory standards or administrative control limits. In comparison, the alternatives involving the construction and operation of a non-nuclear power generating facility would also result in unavoidable exposure to hazardous and toxic chemicals, for workers and the public.

The generation of spent nuclear fuel and waste material, including low-level radioactive waste, hazardous waste, and nonhazardous waste, would be unavoidable. Hazardous and nonhazardous wastes would be generated at some non-nuclear power generating facilities. Wastes generated during nuclear power plant operations would be collected, stored, and shipped for suitable treatment, recycling, or disposal in accordance with applicable Federal and State regulations. Due to the costs of handling these materials, the NRC staff expects that nuclear power plant operators would optimize all waste management activities and operations in a way that generates the smallest possible amount of waste.

3.16.2 Relationship between Short-Term Use of the Environment and Long-Term Productivity

The operation of power generating facilities would result in short-term uses of the environment, as described in Sections 3.2 through 3.13 (see subsections titled, “Proposed Action,” “No-Action Alternative,” and “Replacement Power Alternatives: Common Impacts”). Short term is the period of time that continued power generating activities take place.

Nuclear power plant operations require short-term use of the environment and commitment of resources (e.g., land and energy), indefinitely or permanently. Certain short-term resource commitments are substantially greater under most energy alternatives, including license renewal, than under the no-action alternative because of the continued generation of electrical power and the continued use of generating sites and associated infrastructure. During operations, all energy alternatives entail similar relationships between local short-term uses of the environment and the maintenance and enhancement of long-term productivity.

Air emissions from nuclear power plant operations introduce small amounts of radiological and nonradiological emissions to the region around the nuclear power plant site. Over time, these emissions would result in increased concentrations and exposure, but the NRC staff does not expect that these emissions would impact air quality or radiation exposure to the extent that they would impair public health and long-term productivity of the environment.

Continued employment, expenditures, and tax revenues generated during nuclear power plant operations directly benefit local, regional, and State economies over the short term. Local governments investing project-generated tax revenues into infrastructure and other required services could enhance economic productivity over the long term.

The management and disposal of spent nuclear fuel, low-level radioactive waste, hazardous waste, and nonhazardous waste require an increase in energy and consume space at treatment, storage, or disposal facilities. Regardless of the location, the use of land to meet waste disposal needs would reduce the long-term productivity of the land.

Nuclear power plant facilities are committed to electricity production over the short term. After these facilities are decommissioned and the area restored, the land could be available for other future productive uses.

3.16.3 Irreversible and Irretrievable Commitment of Resources

Resource commitments are irreversible when primary or secondary impacts limit the future options for a resource. For example, the consumption or loss of nonrenewable resources is irreversible. An irretrievable commitment refers to the use or consumption of resources for a period of time (e.g., for the duration of the action under consideration) that are neither renewable nor recoverable for future use. Irreversible and irretrievable commitments of resources for electrical power generation include the commitment of land, water, energy, raw materials, and other natural and human-made resources required for nuclear power plant operations. In general, the commitments of capital, energy, labor, and material resources are also irreversible.

The implementation of any of the replacement energy alternatives considered in this EIS would entail the irreversible and irretrievable commitments of energy, water, chemicals, and—in some cases—fossil fuels. These resources would be committed during the license renewal term and over the entire life cycle of the nuclear power plant, and they would be unrecoverable.

Energy expended would be in the form of fuel for equipment, vehicles, and nuclear power plant operations and electricity for equipment and facility operations. Electricity and fuel would be purchased from offsite commercial sources. Water would be obtained from existing water supply systems or withdrawn from surface water or groundwater. These resources are readily available, and the NRC staff does not expect that the amounts required would deplete available supplies or exceed available system capacities.

4 CONCLUSION

This site-specific EIS contains the NRC staff's environmental review of Dominion Energy Virginia's (Dominion's) application for subsequent license renewal of the renewed operating licenses for North Anna Power Station, Units 1 and 2 (North Anna) for an additional 20 years, as required by Title 10 of the *Code of Federal Regulations* (10 CFR), "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions" (The regulations in 10 CFR Part 51 implement the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.; TN661). This chapter briefly summarizes the environmental impacts of SLR, lists and compares the environmental impacts of alternatives to SLR, and presents the NRC staff's preliminary conclusions and recommendation.

4.1 Environmental Impacts of License Renewal

After reviewing the site-specific environmental issues in this EIS, the NRC staff conclude that issuing subsequent renewed facility operating licenses for North Anna would have SMALL impacts. The NRC staff considered mitigation measures for each environmental issue, as applicable. The NRC staff concluded that no additional mitigation measure is warranted.

4.2 Comparison of Alternatives

In Chapter 3 of this draft site-specific EIS, the NRC staff considered the following alternatives to issuing subsequent renewed facility operating licenses for North Anna:

- no-action alternative
- new nuclear (small modular reactor) alternative
- combination alternative

Based on the evaluation presented in this draft EIS, the NRC staff concludes that the environmentally preferred alternative is the proposed action. The NRC staff recommends that an SLR be issued to Dominion for North Anna. As shown in Table 2-2, all other power-generation alternatives have impacts in at least four environmental resource areas that are greater than SLR, in addition to the environmental impacts inherent with new construction projects. To make up the lost power generation if the NRC does not issue subsequent renewed facility operating licenses for North Anna (i.e., the no-action alternative), energy decision-makers may implement one of the replacement power alternatives discussed in Chapter 3, or a comparable alternative capable of replacing the power generated by North Anna.

4.3 Recommendation

The NRC staff's preliminary recommendation is that the adverse environmental impacts of SLR for North Anna are not so great that preserving the option of SLR for energy-planning decision-makers would be unreasonable. This preliminary recommendation is based on the following:

- Dominion's ER, as supplemented
- NRC staff consultations with Federal, State, Tribal, and local agencies
- NRC staff independent environmental review
- NRC staff consideration of public comments

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6 LIST OF PREPARERS

Members of the NRC Office of Nuclear Material Safety and Safeguards prepared this draft site-specific environmental impact statement (draft EIS) with assistance from other NRC organizations and Pacific Northwest National Laboratory (PNNL). Table 6-1 identifies each contributor's name, education and experience, and function or expertise.

Table 6-1 List of Preparers

Name	Education and Experience	Function or Expertise
Beth Alferink, NRC	MS Environmental Engineering; MS Nuclear Engineering; BS Nuclear Engineering; 25 years of national laboratory, industry, and government experience including radiation detection and measurements, nuclear power plant emergency response, operations, health physics, decommissioning, shielding and criticality	Human Health, Termination of Operations and Decommissioning, Radiological and Nonradiological Waste Management, Uranium Fuel Cycle
Briana Arlene, NRC	Master's Certification, National Environmental Policy Act; BS Conservation Biology; 18 years of experience in ecological impact analysis, Endangered Species Act Section 7 consultations, and Essential Fish Habitat consultations	Aquatic Resources, Special Status Species and Habitats, Microbiological Hazards; ESA Section 7 Consultation; Essential Fish Habitat Consultation
Phyllis Clark, NRC	MS Nuclear Engineering; M.B.A, Business Administration; BS Physics; 39 years of industry and Government experience including nuclear power plant and production reactor operations, systems engineering, reactor engineering, fuels engineering, criticality, power plant emergency response, and project management	Radiological and Waste Management, Uranium Fuel Cycle
Peyton Doub, NRC	MS Plant Physiology (Botany); BS Plant Sciences (Botany); Duke NEPA Certificate; Professional Wetland Scientist; Certified Environmental Professional; 31 years of experience in terrestrial and wetland ecology and NEPA	Terrestrial Ecology, Land Use, and Visual Resources
Jerry Dozier, NRC	MS Reliability Engineering; MBA Business Administration; BS Mechanical Engineering; 31 years of experience including operations, reliability engineering, technical reviews, and NRC branch management	SAMA, Postulated Accidents

Table 6-1 List of Preparers (Continued)

Name	Education and Experience	Function or Expertise
Elijah Dickson, NRC	PhD Radiation Health Physics; MHP Radiation Health Physics; BS Radiation Health Physics; 16 years of experience in radiological consequence analysis, source terms, probabilistic risk assessment, technical reviews.	SAMA, Postulated Accidents
Robert Elliott, NRC	BS Marine Engineering; Licensed Professional Engineer; 30 years of Government experience including containment systems analysis, balance of plant analysis, evaluation of integrated plant operations/technical specifications, and project management, with 14 years of management experience	Management Oversight
Kevin Folk, NRC	MS Environmental Biology; BA, Geoenvironmental Studies; 31 years of experience in NEPA compliance; geologic, hydrologic, and water quality impacts analysis; utility infrastructure analysis, environmental regulatory compliance; and water supply and wastewater discharge permitting	Geologic Environment, Cooling and Auxiliary Water Systems Surface Water Resources, Termination of Operations and Decommissioning
Joseph Giacinto, NRC	MS Hydrology; BS Geology/Geophysics; Certified Professional Geologist; Duke NEPA Certificate; 31 years of combined industry and government experience including performing and managing NEPA reviews for power plants and Superfund sites	Groundwater
Robert Hoffman, NRC	BS Environmental Resource Management; 36 years of experience in NEPA compliance, environmental impact assessment, alternatives identification and development, and energy facility siting	Historic and Cultural Resources, Cumulative Impacts, Replacement Power Alternatives
Caroline Hsu, NRC	BA in Molecular Biology; BA in English Literature; 13 years of government experience; 4 years of management experience	Terrestrial Ecology, Land Use, and Visual Resources
Nancy Martinez, NRC	BS Earth and Environmental Science; A.M. Earth and Planetary Science; 8 years of experience in environmental impact analysis	Air Quality, Meteorology and Climatology, Noise, Greenhouse Gas, Climate Change, Surface Water

Table 6-1 List of Preparers (Continued)

Name	Education and Experience	Function or Expertise
Donald Palmrose, NRC	BS Nuclear Engineering; MS Nuclear Engineering; PhD Nuclear Engineering; 35 years of experience including operations on U.S. Navy nuclear powered surface ships, technical and NEPA analyses, nuclear authorization basis support for DOE, and NRC project management.	Human Health, Uranium Fuel Cycle
Jeffrey Rikhoff, NRC	M.R.P. Regional Environmental Planning; MS Development Economics; BA English; 43 years of combined industry and Government experience in NEPA compliance for DOE Defense Programs/National Nuclear Security Administration and Nuclear Energy, Department of Defense, and Department of the Interior; project management; project management; socioeconomics and environmental justice impact analysis, historic and cultural resource impact assessments, consultations with American Indian tribes, and comprehensive land-use and development planning studies	Replacement Energy Alternatives, Socioeconomics, Environmental Justice, Cumulative Effects
Ted Smith, NRC	MS Environmental Engineering; BS Electrical Engineering; 38 years of experience, including DOE Power Administration, support of site Environmental Management programs, and spent fuel management, oversight of U.S. Navy nuclear ships design, construction, and operation, NRC project management and management	Management Oversight
Tam Tran, NRC	MBA Management; MS Environmental Science; MS Nuclear Engineering; more than 31 years of Federal project and program management experience	Project Management
Rebecka Bence, PNNL	MS Hydrogeology and Water Resource Management; BS Earth and Environmental Science 5+ years in groundwater resource assessment and environmental impact evaluation, contaminated land risk assessment and remediation, and natural resource management and monitoring	Groundwater Resources, Geologic Environment

Table 6-1 List of Preparers (Continued)

Name	Education and Experience	Function or Expertise
Teresa Carlon, PNNL	BS Information Technology 30 years of experience as SharePoint administrator, project coordinator, and databases	Reference Coordinator
Caitlin Condon, PNNL	PhD Radiation Health Physics BS Environmental Health 6 years of experience in health physics, NEPA environmental impact assessments, waste management, radionuclide dispersion and dosimetry modeling.	Project Management
Susan Ennor, PNNL	BA Journalism 40 years of experience in document planning, editing, and production	Production Editor
Tracy Fuentes, PNNL	PhD Urban Design and Planning MS Plant Biology BS Botany Over 15 years of experience, including NEPA planning; environmental impact analysis, environmental resource monitoring, data analysis, and research	Land Use, Terrestrial Resources
Dave Goodman, PNNL	J.D. Law BS Economics 12 years of experience including NEPA environmental impact assessments, ecological restoration, *Endangered Species Act*, land use and visual resources, and environmental law and policy	Cumulative Impacts, NEPA Regulatory Analyst
Philip Meyer, PNNL	PhD Civil Engineering MS Civil Engineering BA Physics 30+ years of experience in applied groundwater and unsaturated zone research; 15+ years of experience in groundwater resource assessment and environmental impact evaluation	Groundwater Resources, Geologic Environment
Ann Miracle, PNNL	PhD Molecular Immunology MS Molecular Genetics BA Biology Over 15 years of experience in ecological impact analysis, Endangered Species Act Section 7 consultations, and EFH consultations	Terrestrial Resources
Jaime Moore, PNNL	M.P.M Master of Project Management BS Business Administration 23 years of Project Management Experience	Project Management

Table 6-1 List of Preparers (Continued)

Name	Education and Experience	Function or Expertise
Michelle Niemeyer, PNNL	MS Agricultural Economics BS Agricultural Economics	Environmental Justice, Socioeconomics
Mike Parker, PNNL	BA English Literature 25 years of experience copyediting, document design, and formatting and 20 years of experience in technical editing	Production
Rajiv Prasad, PNNL	PhD Civil and Environmental Engineering M.Tech Civil Engineering B.E. Civil Engineering 25 years of experience in applying hydrologic principles to water resources engineering, hydrologic design, flooding assessments, environmental engineering, and impacts assessment including 15 years of experience in NEPA environmental assessments of surface water resources	Surface Water Resources
Adrienne Rackley, PNNL	MS Economics BA Business Administration A.A. General Studies	Environmental Justice, Socioeconomics
Kazi Tamaddun, PNNL	PhD Civil and Environmental Engineering MS Civil Engineering 8 years of experience in hydrologic, hydraulic, ecosystem, and water systems modeling; hydro-climatology; climate change modeling and analysis	Surface Water Resources

7 LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM THE U.S. NUCLEAR REGULATORY COMMISSION SENDS COPIES OF THIS ENVIRONMENTAL IMPACT STATEMENT

Table 7-1 List of Agencies, Organizations, and Persons to Whom the U.S. Nuclear Regulatory Commission Sends Copies of this Environmental Impact Statement

Name	Affiliation
John Cruickshank	Piedmont of the Sierra Club
William Johnson	NA
Diana Johnson	NA
Virginia McCormack	NA
Kimberly Cleland	NA
Edward Bogdan	Loudoun Climate Project
Steve Duggan	NA
Elena Day	NA
Paula Chow	NA
Edward Sandtner	NA
Natalie Pien	Sierra Club, Great Falls Group
Alane Callander	NA
James Lynch	NA
Erica Gray	NA
Andy Wade	County of Louisa
Don Safer	Tennessee Environmental Council and Nuclear Free Team of the Sierra Club
Fred Mladen	Dominion Energy
Robert Babyok	Louisa County Board of Supervisors
Thomas Saporito	Nuclear Energy Oversight Project
Bettina Rayfield, Manager	Commonwealth of Virginia Virginia Department of Environmental Quality Environmental Impact Review
Stepan Nevshehirlian	U.S. Environmental Protection Agency Region 3
Stephen Tryon, Director	U.S. Department of Interior Office of Environmental Policy and Compliance Attention: Shawn Alam
Diane Curran, Esq.	Harmon, Curran, Spielberg, & Eisenberg, L.L.P.
Curtis Brown, State Coordinator	Commonwealth of Virginia
Lea Perlas, Interim Director	Virginia Office of Radiological Health
Judy Lamana, Founder	Fauquier Climate Change Group
Phil Carlson	NA

NA denotes no affiliation identified. Included in the list above are the names of persons who submitted comments on one or both of the two scoping reports. Many scoping commenters did not provide their contact or affiliation information. The NRC staff has listed the names of these commenters in the scoping summary reports (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML21181A127 and ML23326A100). The commenters were offered an opportunity to receive this EIS. However, the staff could not send a copy of this EIS to commenters who did not provide contact information and those persons are not listed here. In addition, Appendix C, “Consultation Correspondence,” lists correspondence with agencies and Tribes, including distribution of the EIS.

APPENDIX A

COMMENTS RECEIVED ON THE NORTH ANNA POWER STATION, UNITS 1 AND 2 2021 DSEIS ENVIRONMENTAL REVIEW

A.1 Comments Received During the 2020 Scoping Period

The U.S. Nuclear Regulatory Commission (NRC) staff began the scoping process for the environmental review of the North Anna Power Station, Units 1 and 2 (North Anna) subsequent license renewal (SLR) application in October 2020, in accordance with the National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. § 4321, et seq-TN8608). On October 19, 2020, the NRC issued a notice of intent to conduct an environmental scoping process for North Anna SLR that was published in the *Federal Register* on October 23, 2020 (85 FR 67572-TN8294). *Federal Register* notices are searchable using the notice number (e.g., xx FR xxxx) at Regulations.gov. In its notice, the NRC requested that members of the public and stakeholders submit comments on the North Anna SLR environmental review to the Federal Rulemaking Website at Regulations.gov.

As part of the environment impact statement (EIS) scoping process, the NRC staff held a public meeting on November 4, 2020. Because of the COVID-19 public health emergency, the NRC staff conducted the public meeting in the form of a Webinar. Members of the public were able to participate in the meeting online via computer or by dialing in via phone. To advertise this public meeting, the NRC staff issued press releases and purchased newspaper advertisements. In addition to the NRC staff, Dominion staff, and local officials, several members of the public attended the public meeting. After the NRC staff presented its prepared statements on the SLR process, the staff opened the meeting for public comments. Attendees made oral statements that were recorded and transcribed by a certified court reporter. A summary and a transcript of the public scoping meeting is available in the NRC's Agencywide Documents Access and Management System (ADAMS) under ADAMS Accession No. ML20324A259. The ADAMS Public Electronic Reading Room is accessible at http://www.nrc.gov/reading-rm/adams.html.

At the conclusion of the 2020 scoping period, the staff issued the North Anna Scoping Summary Report, dated June 2021. (ADAMS Accession No. ML21181A127; NRC 2021-TN8295). The report (a) contains comments received during the public meeting and through Regulations.gov, (b) groups these comments by subject area, and (c) contains the NRC staff's responses to these comments.

A.2 Comments Received on the Draft Supplemental Environmental Impact Statement

On August 19, 2021, the NRC issued and distributed the "Generic Environmental Impact Statement for License Renewal of Nuclear Plants Regarding Subsequent License Renewal for North Anna Power Station, Units 1 and 2 (NUREG-1437, Supplement 7, Second Renewal), Draft Report for Comment" (draft Supplemental Environmental Impact Statement [DSEIS]), to Federal, Tribal, State, and local government agencies and interested members of the public. In addition, the U.S. Environmental Protection Agency (EPA) issued its notice of availability in the *Federal Register* on August 27, 2021 (86 FR 48139-TN8610) for public comment, and the NRC issued its notice of availability for public comment on August 25, 2021 (86 FR 47525-TN8611). The public comment period ended on October 12, 2021. As part of the process to solicit public comments on the DSEIS, the NRC staff did the following:

- placed copies of the DSEIS at the following public library: Louisa Library, 881 Davis Hwy, Mineral, VA 23117
- made a copy of the DSEIS available in the NRC's Public Document Room in Rockville, Maryland
- placed a copy of the DSEIS on the NRC website at: https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1437/
- provided a copy of the DSEIS to any member of the public who requested one
- sent copies of the DSEIS to certain Federal, Tribal, State, and local government agencies and interested members of the public
- published a notice of availability of the DSEIS in the *Federal Register* on August 25, 2021 (86 FR 47525-TN8611);86 FR 47525-TN8611)
- filed the DSEIS with the EPA
- held a virtual public meeting, on September 28, 2021, to describe the preliminary results of the environmental review, answer any related questions, and collect public comments. On December 10, 2021, the staff issued a public meeting summary of this meeting (ADAMS Accession No. ML21293A099).

At the end of the DSEIS public comment period, the staff collected the comments on the DSEIS as listed in Table A-1. Each commenter is identified by the commenter's ID number and comment source document number in ADAMS. The staff considered these comments in preparing this site-specific draft EIS.

Table A-1 Commenters, Comment Sources, and Staff Responses

Commenter	Affiliation	Staff Response Section Numbers	Comment Source	ADAMS Accession No.
E. Hendrixson	Ashland, VA Resident	A.2.1, A.2.14, A.2.16	Regulations.Gov	ML21245A389
J. Lamana	Fauquier Climate Change Group	A.2.1, A.2.14	Regulations.Gov	ML21272A352
G. Woods	Town of Orange, VA	A.2.14	Email	ML21277A137
V. Fulcher	Virginia DEQ	A.2.1, A.2.2, A.2.3, A.2.4, A.2.5, A.2.6, A.2.7, A.2.12	Email	ML21279A018

Table A-1 Commenters, Comment Sources, and Staff Responses (Continued)

Commenter	Affiliation	Staff Response Section Numbers	Comment Source	ADAMS Accession No.
J. Cruickshank	Earlysville, VA Resident	A.2.12, A.2.13, A.2.14, A.2.15	Email	ML21279A019
M. Sartain	Dominion Energy	A.2.1, A.2.2, A.2.3, A.2.4, A.2.5, A.2.9, A.2.11	Document Control Desk	ML21280A357
D. Berlin	Charlottesville, VA Resident	A.2.14	Regulations.Gov	ML21281A022
M. Pillow	Crozet, VA Resident	A.2.12, A.2.13, A.2.14, A.2.15	Regulations.Gov	ML21281A023
A. McKeithen	Charlottesville, VA Resident	A.2.13, A.2.15	Regulations.Gov	ML21281A025
J. Surr	Charlottesville, VA Resident	A.2.12, A.2.13, A.2.15	Regulations.Gov	ML21286A739
B. Hodsdon	Crozet, VA Resident	A.2.12, A.2.13, A.2.15	Email	ML21284A012
D. Shaunesey	Charlottesville, VA Resident	A.2.12, A.2.13, A.2.15	Regulations.Gov	ML21286A740
W. Johnson	Fredericksburg, VA Resident	A.2.12, A.2.13, A.2.15	Regulations.Gov	ML21286A741
K. Johnson	Charlottesville, VA Resident	A.2.12, A.2.13, A.2.14	Regulations.Gov	ML21286A742
NA (ucanmailjackie@yahoo.com)	Sierra Club	A.2.12, A.2.13, A.2.14, A.2.15	Regulations.Gov	ML21286A744
P. Gordon	Charlottesville, VA Resident	A.2.12, A.2.13, A.2.14	Regulations.Gov	ML21286A745

Table A-1 Commenters, Comment Sources, and Staff Responses (Continued)

Commenter	Affiliation	Staff Response Section Numbers	Comment Source	ADAMS Accession No.
D. Erwin	NA	A.2.12, A.2.15	Email	ML21284A010
B. Lankford	NA	A.2.14	Email	ML21284A011
Concerned Citizen	Madison County, VA Resident	A.2.1	Regulations.Gov	ML21286A746
J. Gillespie	U.S. EPA	A.2.1, A.2.2, A.2.7, A.2.10, A.2.13	Email	ML21285A308
P. Gunter	Reactor Oversight Project Beyond Nuclear	A.2.13, A.2.14	Email	ML21285A323
A. Schefer	Fredericksburg, VA Resident	A.2.12, A.2.13, A.2.14	Regulations.Gov	ML21286A747
Denise Schefer	Warrenton, VA Resident	A.2.12, A.2.13, A.2.14	Regulations.Gov	ML21286A748
L. Schefer	Warrenton, VA Resident	A.2.14, A.2.15	Regulations.Gov	ML21286A749
Danielle Schefer	Arlington, VA Resident	A.2.12, A.2.13, A.2.14	Regulations.Gov	ML21286A750
S. Bannon	Arlington, VA Resident	A.2.13	Regulations.Gov	ML21286A751
E. Toombs	Cherokee Nation	A.2.8	Regulations.Gov	ML21298A141

NA denotes the information is not available either in writing or verbally.

The remaining portions of Section A.1 present the summaries of comments (or extraction of comments from the original submittals) and the NRC staff's responses to the comments. In cases where the staff has incorporated information from a public comment on the DSEIS into this draft site-specific EIS, NRC staff's response(s) in this appendix indicate(s) such changes. In cases where comments did not warrant further consideration, the NRC staff explains why by citing sources, authorities, or reasons that support the staff's conclusion.

The following environmental areas were the subjects of comment on the DSEIS:

- Replacement Power Alternatives and No-Action Alternative
- Air Quality and Meteorology
- Geologic Environment

- Surface Water Resources
- Groundwater Resources
- Terrestrial Resources
- Aquatic Resources
- Historic and Cultural Resources
- Human Health
- Environmental Justice
- Postulated Accidents and Severe Accident Mitigation Alternatives
- Waste Management
- License Renewal Process and NEPA (challenges to NRC regulations—rulemaking petition comments)
- General Opposition to or Support of License Renewal
- Outside of Scope—Operational Safety Issues, Safety Concerns, Dam Safety, and Chernobyl Concerns
- Outside of Scope—Operation Economics

A.2.1 Replacement Power Alternatives and No-Action Alternative

Comment: As part of the Environmental Impact Statement, I encourage the NRC to consider (and calculate) the impacts of:

1) Replacement of 24/7 electrical generation. What are the current viable sources? Some would be solar/wind, but these are not 24/7 forms of electricity. Storage of 1,900 MWe of power is not viable through batteries. Most notably, Natural Gas and/or Coal would be needed to handle summer/winter peaking. The CO2 effects need to be incorporated. (Hendrixson, Eric)

2) The Environmental Impact of constructing 1,900 MWe of 24/7 electrical production. For instance, solar is only 25% efficient, so 7,600 MWe of Solar would need to be constructed to replace North Anna Power Station. The Environmental Impact of producing this many solar panels (including the mining of rare earth metals), and the land impact of a 7,600 MWe solar farm in central Virginia needs to be part of the Environmental Impact Statement. This also must include the proper decommissioning and disposal of these 7,600 MWe of solar, since they have a finite life. The same logic needs to be applied to any wind that is proposed (only 60% efficient). (Hendrixson, Eric)

Comment: The DSEIS states alternatives were dismissed due to technical, resource availability, or commercial limitations that currently exist and that the NRC staff believes are likely to still exist when the current North Anna licenses expire. As technologies continue to evolve in capabilities and cost, EPA recommends, due to the advance nature of the DSEIS, NRC and Dominion conduct a re-evaluation of conditions before commencement of the proposed action. New information may be available, and other alternatives or combination of alternatives may be more commercially viable. Furthermore, a re-evaluation may capture unforeseen area population growth or additional stressors on the air or water resources that may not have [been] accounted for in the DSEIS. (Gillespie, Joy)

Comment: The North Anna facility located in Louisa County, Virginia, needs renewable energy alternatives to the subsequent license renewal. (Concerned Citizen)

Comment: The Environmental Impact Statement should include the adverse effects of building so much extra replacement power. The Environmental Impact Statement should consider the impact of the raw construction, as well as the long term negative effects to the extraordinary land usage that replacement Electrical Generation would entail. Finally, Economic impacts are real, and should be considered. (Hendrixson, Eric)

Comment: The Combination Alternative (Solar, Offshore Wind, Small Modular Reactor, and Demand-Side Management) that is also under consideration by the NRC is more resource intensive than renewing the license for the two existing nuclear power plants as new construction would be required. In terms of land needs alone, the NRC reports that the Combination Alternative would require 20,000 acres of land for the solar energy portion and 72 square-nautical miles of ocean area for the wind power portion. While small modular nuclear reactor facilities would need 36 acres at the Lake Anna site, demand-side management would require no land. (Lamana, Judy)

Response: The purpose and need for the proposed Federal action (issuance of subsequent renewed licenses for North Anna) is to provide an option that allows for power generation capability beyond the term of the current renewed facility operating licenses to meet future system generating needs. Chapter 2 of the draft EIS considers a full range of reasonable replacement power alternatives to subsequent renewal of North Anna's operating licenses, including emerging nuclear, solar, and offshore wind technologies, as well as demand-side management, based on currently available information and reasonably foreseeable developments that are cognizable at this time. These technologies and approaches are expected to be capable of replacing North Anna's power generating capacity, either individually (for new nuclear) or in combination and would be compliant with the Virginia Clean Economy Act's requirements for reducing carbon emissions. Section 2.4 discusses other alternatives that were considered to be not reasonable and were eliminated from detailed study, including coal and natural gas. Chapter 3 of the draft EIS presents the environmental and socioeconomic impacts that would be associated with the construction and operation of reasonable replacement power alternatives. In addition, Section 3.16 of the draft EIS addresses potential long-term cumulative impacts of the proposed action, up to the end of the 20-year SLR term, including predicted changes in regional development, as well as water use and water quality considerations.

As discussed in Section 2.5 of the draft EIS, the environmental impacts of the proposed action (issuing subsequent renewed facility operating licenses for North Anna) would be SMALL for all impact categories. In comparison, each of the two reasonable replacement power alternatives (i.e., the new nuclear alternative, and the combination alternative consisting of nuclear, solar, offshore wind, and demand-side management) has environmental impacts in at least four resource areas that are greater than the environmental impacts of the proposed action of SLR. Accordingly, the NRC staff concludes that the environmentally preferred alternative is the proposed action of SLR. No changes were made to the NRC staff's environmental evaluation as a result of this comment.

Comment: DSEIS Section 2.1.2, page 2-3, lines 1-2 reflect the following:

"The nuclear reactors produce a nominal core power rating of 2,775 megawatts thermal (MWt) (Dominion 2020b)." The value of 2,775 megawatts thermal appears to conflict with the information provided in Environmental Report Section E2.2.2.2.

Recommend revising to:

"The nuclear reactors produce a nominal core power rating of 2,940 megawatts thermal (MWt) (Dominion 2020b)." (Sartain, Mark)

Response: The NRC staff agrees with the comment and has incorporated information from this comment into Section 2.1.2 of the draft EIS to be consistent with Section 2.2.1.1 of the environmental report.

Comment: Energy Conservation. The facility should be planned and designed to comply with state and federal guidelines and industry standards for energy conservation and efficiency. The commonwealth encourages architectural and engineering designers to recognize and incorporate the energy, environmental, and sustainability concepts listed in the Leadership in Energy and Environmental Design (LEED) Green Building Rating System into the development and procurement of their projects. The energy efficiency of the facility can be enhanced by maximizing the use of the following: thermally- efficient building shell components (roof, wall, floor, windows, and insulation); high efficiency heating, ventilation, air conditioning systems; high efficiency lighting systems and daylighting techniques; and energy-efficient appliances. (Fulcher, Valerie)

Response: The NRC staff acknowledges these recommendations and appreciates the information provided by the Virginia Department of Environmental Quality (VDEQ). As stated in Sections 2.2.1 and 2.2.2 of the draft EIS, Dominion has not proposed any facility modifications, new construction, or major refurbishment activities to support the NRC's proposed action (SLR) and continued operation of North Anna. The staff notes that it is beyond the NRC's authority to require Dominion to implement the recommended energy efficiency measures. The NRC's authority concerns the protection of public health and safety from the effects of radiation from nuclear reactors, materials, and waste facilities. This comment provides no significant new information. No changes were made to the NRC staff's environmental evaluation as a result of this comment.

Comment: 4) The impact on Lake Anna also needs to be considered. The lake was built to support the power plant. With no flow through the WHTF [waste heat treatment facility], what will be the impact on the aquatic life? Indeed, would the Dam at the end of the lake be removed? If not, who will maintain the Dam? Clearly not Dominion, since the purpose of the Dam (to support North Anna Power Station) would be eliminated. In addition to the obvious negative consequences to the residents around the lake, this also has consequences for downstream users on the North Anna and Pamunkey rivers. (Hendrixson, Eric)

Comment: 4) The negative impact on the citizens of Louisa County must be considered. The loss of revenue (direct and indirect) are consequential. (Hendrixson, Eric)

Response: Chapter 3 of the draft EIS presents the environmental and socioeconomic impacts that would be associated with not renewing the North Anna renewed facility operating licenses under the No-Action alternative, including impacts on Lake Anna and the regional economy. If North Anna ceases operation, the NRC staff expects that Dominion would continue to own and manage Lake Anna, would continue to make the minimum required releases from Lake Anna to the North Anna River as required by the Virginia Pollutant Discharge Elimination System (VPDES) permit, and would support the continued operation of the Lake Anna Hydro Power Station. No changes were made to the NRC staff’s environmental evaluation as a result of these comments.

A.2.2 Air Quality and Meteorology

Comment: DSEIS Section 3.3.1, page 3-14, lines 27-28 reflect the following:

"The mean annual temperature from the North Anna onsite meteorological tower is 51.7 °F (10.9 °C)"

The value of 51.7 °F (10.9 °C) appears to conflict with the information provided in the Environmental Report Table E3.3-4.

Recommend revising to:

"The mean annual temperature from the North Anna onsite meteorological tower is 57.2 °F (14 °C) ..." (Sartain, Mark)

Response: The NRC staff agrees with the comment and has incorporated information from this comment into Section 3.3.1 of the draft EIS, to be consistent with the mean annual temperature from the North Anna's onsite meteorological tower of 57.2 °F (14 °C).

Comment: 6(c) Recommendation. Dominion should take all reasonable precautions to limit emissions of NOx and VOCs during facility construction and operation activities, principally by controlling or limiting the burning of fossil fuels.

6(d) Requirements. Dominion must evaluate all potential sources of air emissions for the facility, including but not limited to boilers, generators, and cooling towers, and submit an application to DEQ-NRO for a permit (or amendment), if necessary. Any required air permit must be obtained prior to future construction activities.

(i) Fugitive Dust

During construction, fugitive dust must be kept to a minimum by using control methods outlined in 9 VAC 5-50-60 et seq. of the Regulations for the Control and Abatement of Air Pollution. These precautions include, but are not limited to, the following:

Use, where possible, of water or chemicals for dust control;

Installation and use of hoods, fans, and fabric filters to enclose and vent the handling of dusty materials; Covering of open equipment for conveying materials; and Prompt removal of spilled or tracked dirt or other materials from paved streets and removal of dried sediments resulting from soil erosion.

(ii) Asphalt Paving

In accordance with 9 VAC 5-45-780, there are limitations on the use of [“]cut-back" (liquefied asphalt cement, blended with petroleum solvents) that may apply to paving activities associated with ongoing facility construction and maintenance activities. Moreover, there are time-of-year restrictions on its use during the months of April through October in VOC emission control areas.

(iii) Open Burning

If activities include the open burning of construction material or the use of special incineration devices, this must meet the requirements under 9 VAC 5-130 et seq. of the Regulations for open burning and may require a permit. The Regulations provide for, but do not require, the local adoption of a model ordinance concerning open burning. Dominion should contact local fire officials to determine what local requirements, if any, exist.

(iv) Fuel Burning Equipment

The installation of fuel burning equipment (e.g., boilers and generators), may require permitting from DEQ prior to beginning construction (9 VAC 5-80, Article 6, Permits for New and Modified Sources). Dominion should contact DEQ-NRO for guidance on whether this provision applies. (Fulcher, Valerie)

Comment: COMMENTS SPECIFIC TO THE PROJECT: All precautions are necessary to restrict the emissions of volatile organic compounds (VOC) and oxides of nitrogen (NOX) if any construction is involved. For any changes in permit or its extension, our Northern Regional Office maybe consulted. (Fulcher, Valerie)

Response: Section 3.3.3 of the draft EIS discusses Dominion's Air State Operating Permit, air emission sources as a result of operation of North Anna, and the compliance history with respect to the State Operating Permit and evaluates the contributions of air emissions from continued operation of North Anna. As discussed in Section 3.3.3 of the draft EIS, Dominion does not anticipate refurbishment or construction activities during the proposed subsequent relicensing term and therefore, air emissions from the North Anna plant during the SLR term are anticipated to remain the same. Dominion is responsible for securing, as necessary, air permits from the VDEQ, and the VDEQ has the authority to regulate air quality. The staff notes that it is beyond the NRC's authority to require Dominion to implement the recommended mitigation measures. The NRC's authority is limited by statute to the protection of public health and safety from the effects of radiation from nuclear reactors, materials, and waste facilities. No changes were made to the NRC staff's environmental evaluation as a result of these comments.

Comment: Recommend the SEIS include a detailed discussion of the action's GHG emissions in the context of national, regional, or State GHG emission reduction goals, as appropriate, over the anticipated action lifetime and address any conflict over time between continued emissions and national GHG emissions reduction goals, including ways to avoid or mitigate that conflict. (Gillespie, Joy)

Response: Section 3.14 of the draft EIS has been updated to discuss the Virginia Clean Economy Act, which established an energy policy to reach net-zero greenhouse gas emissions by 2045. As also discussed in Section 2.4 of the draft EIS, the Virginia Clean Economy Act mandates that electric generation within the Commonwealth of Virginia, including Dominion Energy's, be 100-percent carbon-free by 2045 and would require the closure of all carbon-emitting power plants that generate electricity. Greenhouse gas emissions associated with the proposed action and alternatives were discussed within the context of the Virginia Clean Economy Act.

A.2.3 Geologic Environment

Comment: DSEIS Section 3.4.1, page 3-22, lines 41-43 reflect the following:

"The size and number of fractures and faults in the bedrock decrease with depth as the bedrock becomes less weathered and more structurally competent." The use of the term "faults" appears to conflict with the information provided in Environmental Report Section E3.6.2.1.

Recommend revising to:

'The size and number of joints and fractures in the bedrock decrease with depth as the bedrock becomes less weathered and more structurally competent." (Sartain, Mark)

Response: The NRC staff revised the phrase cited by the commenter in Section 3.4.1 of the draft EIS to replace the word “faults” with “joints” for accuracy and clarity.

Comment: Erosion and Sediment Control Plan. The Applicant is responsible for submitting a project-specific erosion and sediment control (ESC) plan to the locality in which the project is located for review and approval pursuant to the local ESC requirements, if the project involves a land-disturbing activity of 10,000 square feet or more (2,500 square feet or more in a Chesapeake Bay Preservation Area). Depending on local requirements the area of land disturbance requiring an ESC plan may be less. The ESC plan must be approved by the locality prior to any land-disturbing activity at the project site. All regulated land-disturbing activities associated with the project, including on and off site access roads, staging areas, borrow areas, stockpiles, and soil intentionally transported from the project must be covered by the project ESC plan. Local ESC program requirements must be requested through the locality. [Reference: Virginia Erosion and Sediment Control Law §62.1-44.15 et seq.; Virginia Erosion and Sediment Control Regulations 9VAC25-840-10 et seq.] (Fulcher, Valerie)

Response: As stated in Section 2.2.2 of the draft EIS, Dominion has not proposed new construction or major refurbishment activities to support the NRC’s proposed action (subsequent license renewal) and continued operations of North Anna. The NRC staff anticipates that most routine operation and maintenance activities would be confined to previously disturbed areas of the site. If land-disturbing activities occur within the site, Dominion would be responsible for obtaining the required permits and licenses, including ensuring compliance with applicable soil erosion and sediment control requirements. This comment provides no new information. No changes were made to the NRC staff’s environmental evaluation as a result of this comment.

A.2.4 Surface Water Resources

Comment: Surface Waters and Wetlands. 1 of 2

According to the GEIS Supplement 7 (page 3-43), the impacts of nuclear power plant license renewal and continued operations would generally be small. No significant surface water impacts with respect to Category 1 (generic) issues are anticipated during the subsequent license renewal term that would be different from those occurring during the current license term. The GEIS Supplement 7 (page 3-50) states that the North Anna site boundaries include a total of 650 acres of wetland, lake, and riverine waters. Most of the water and wetland acreage is occupied by Lake Anna, with 630 acres inside the North Anna site. Physical disturbance would be limited to paved or disturbed areas or to areas of mowed grass or early successional vegetation and not encroach into wetlands (GEIS Supplement 7, page 3-54).

1(b) Agency Findings.

(i) Department of Environmental Quality

The VWP [Virginia Water Protection] Permit program at the DEQ [or VDEQ] Central Office (CO) notes that measures such as, but not limited to, Best Management Practices (BMPs) must be taken to avoid and minimize impacts to surface waters during construction activities, including potential water quality impacts resulting from construction site runoff. The disturbance of land and surface waters, which include wetlands, open water, and streams, may require prior approval by DEQ, U.S. Army Corps of Engineers (Corps), VMRC [Virginia Marine Resources Commission], and/or local government wetlands boards (generally in the northern and piedmont regions of Virginia). The Corps and DEQ work in conjunction to provide official confirmation of whether there are federal and/or state jurisdictional surface waters that may be impacted by the proposed project. VMRC provides its own review to determine its agency jurisdiction. Review of National Wetland Inventory maps or topographic maps for locating wetlands, open waters, or streams may not be sufficient; there may need to be a site-specific review by a qualified professional. If construction activities will occur in or along any streams (perennial, intermittent, or ephemeral), open water or wetlands, the applicant should contact the DEQ VWP Permit program managers at the DEQ Northern Regional Office (NRO) to determine the need for any permits prior to commencing work that could impact surface waters. DEQ's permit need decisions neither replace nor supersede requirements set forth by other local, state, federal, and tribal laws, nor eliminate the need to obtain additional permits, approvals, consultations, or authorizations as required by law before proposed activities may commence.

(ii) Virginia Marine Resources Commission

VMRC did not indicate that tidal wetlands under its jurisdiction would be impacted. VMRC has no objections to the renewal of the North Anna Power Station operating licenses for Units 1 and 2. (Fulcher, Valerie)

Comment: Surface Waters and Wetlands. 2 of 2

1(c) Requirements. Any future impacts to jurisdictional waters may require a VWP Permit. VMRC serves as the clearinghouse for the submission of Joint Permit Applications (JPAs) used by DEQ, VMRC, Corps and local wetlands boards for the review and issuance of any necessary permits or approvals for impacts to jurisdictional waters. Upon receipt of a JPA, the VWP Permit staff at DEQ-NRO will review the proposed project in accordance with the VWP Permit program regulations and guidance.

1(d) Recommendations. Based upon review of the information provided by the NRC, DEQ-CO offers the following recommendations:

Prior to commencing project work, all wetlands and streams within the project corridor should be field delineated and verified by the Corps, using accepted methods and procedures.

2. Wetland and stream impacts should be avoided and minimized to the maximum extent practicable. Stream impacts should be minimized or avoided by spanning the transmission line across each stream. No foundations should be placed within streambeds. Where

access is required across a wetland, removable mats should be used to reduce compaction and rutting. Towers should be placed avoid wetlands, wherever possible. To the extent where any footings must be installed in wetlands, each footing should occupy the minimum space necessary. When excavation for a structure is necessary in a wetland, excess spoil should not be disposed of in adjacent wetland areas unless authorized by a state or federal wetland permit.

3. If the scope of the action changes, additional review will be necessary by this office.

4. At a minimum, compensation for impacts to state waters, if necessary, should be in accordance with all applicable state wetland regulations and wetland permit requirements, including the compensation for permanent conversion of forested wetlands to emergent wetlands.

5. Any temporary impacts to surface waters associated with this project should require restoration to pre-existing conditions.

6. No activity may substantially disrupt the movement of aquatic life indigenous to the water body, including those species, which normally migrate through the area, unless the primary purpose of the activity is to impound water. Culverts placed in streams must be installed to maintain low flow conditions. No activity may cause more than minimal adverse effect on navigation. Furthermore, the activity must not impede the passage of normal or expected high flows and the structure or discharge must withstand expected high flows.

7. Erosion and sedimentation controls should be designed in accordance with the Virginia Erosion and Sediment Control Handbook, Third Edition, 1992. These controls should be placed prior to clearing and grading and maintained in good working order to minimize impacts to state waters. These controls should remain in place until the area is stabilized and should then be removed. Any exposed slopes and streambanks should be stabilized immediately upon completion of work in each permitted area. All denuded areas should be properly stabilized in accordance with the Virginia Erosion and Sediment Control Handbook, Third Edition, 1992.

8. No machinery may enter surface waters, unless authorized by a VWP Permit.

9. Heavy equipment in temporarily impacted surface waters should be placed on mats, geotextile fabric, or other suitable material, to minimize soil disturbance to the maximum extent practicable. Equipment and materials should be removed immediately upon completion of work.

10. Activities should be conducted in accordance with any Time-of-Year restriction(s) as recommended by the Department of Wildlife Resources, the Department of Conservation and Recreation, or the VMRC. The permittee should retain a copy of the agency correspondence concerning the Time-of-Year restriction(s), or the lack thereof, for the duration of the construction phase of the project.

11. All construction, construction access, and demolition activities associated with this project should be accomplished in a manner that minimizes construction materials or waste materials from entering surface waters, unless authorized by a permit. Wet, excess, or waste concrete should be prohibited from entering surface waters.

12. Herbicides used in or around any surface water should be approved for aquatic use by the United .States. Environmental Protection Agency (EPA) or the U.S. Fish and Wildlife Service. These herbicides should be applied according to label directions by a licensed herbicide applicator. A non-petroleum based surfactant should be used in or around any surface waters.

13. Consider mitigating impacts to forested or converted wetlands by establishing new forested wetlands within the impacted watershed. (Fulcher, Valerie)

Comment: State Subaqueous Lands. The GEIS Supplement 7 does not specifically address potential impacts to state subaqueous lands.

2(b) Agency Findings. VMRC finds that no new work is proposed over state-owned submerged land. VMRC has no objections to the renewal of the North Anna Power Station operating licenses for Units 1 and 2. (Fulcher, Valerie)

Comment: Point Source Discharges. The GEIS Supplement 7 (page 3-93) notes that DEQ has granted Dominion multiple, sequential variances under CWA Section 316(a) associated with the NAPS thermal effluent. Because characteristics of the thermal effluent would remain the same under the proposed action, the NRC staff anticipates similar effects during the proposed SLR period. Further, DEQ will continue to review the CWA Section 316(a) variance with each successive VPDES permit renewal and may require additional mitigation or monitoring in a future renewed VPDES permit if it deems such actions to be appropriate to assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in Lake Anna and the North Anna River downstream of the lake. NRC staff finds that thermal impacts during the proposed SLR period would neither destabilize nor noticeably alter any important attribute of the aquatic environment and would, therefore, result in small impacts on aquatic organisms.

3(b) Agency Findings. The VPDES program at DEQ-NRO notes that NAPS has an Individual VPDES Permit (VA0052451) and is subject to the requirements of Section 316(a) and Section 316(b) of the CWA.

3(c) Requirements. Any changes to the reactors (e.g., uprates, turbine/blade replacements, etc.) that could have an impact on the thermal component of the discharge and may need to be addressed through VPDES permitting under CWA 316(a). Additionally, any work at the intakes or increase in flows related to reactor changes may need to be addressed through VPDES permitting under CWA 316(b). (Fulcher, Valerie)

Comment: Erosion and Sediment Control and Stormwater Management. According to the GEIS Supplement 7 (page 3-23), Dominion maintains a Stormwater Pollution Prevention Plan (SWPPP) for the North Anna site that includes soil erosion and sediment control measures to prevent erosion and potential water quality impacts.

(i) Erosion and Sediment Control Plan

Dominion is responsible for submitting a project-specific Erosion and Sediment Control (ESC) Plan to Louisa County for review and approval pursuant to the local ESC requirements, for future construction involving land-disturbing activities of 10,000 square feet or more. Depending on local requirements the area of land disturbance requiring an ESC Plan may be less. The ESC Plan must be approved by the locality prior to any land-disturbing activity at the project site. All regulated land-disturbing activities associated with the project, including on and off site access roads, staging areas, borrow areas, stockpiles, and soil intentionally transported from the project must be covered by the project-specific ESC Plan. Local ESC program requirements must be requested through the locality. [Reference: Virginia Erosion and Sediment Control Law §62.1-44.15 et seq.; Virginia Erosion and Sediment Control Regulations 9 VAC 25-840---10 et seq.]

(ii) Stormwater Management Plan

Depending on local requirements, a Stormwater Management (SWM) Plan may be required for future construction. Local SWM program requirements must be requested through the locality. [Reference: Virginia Stormwater Management Act §62.1-44.15 et seq.; Virginia Stormwater Management (VSMP) Permit Regulations 9 VAC 25-870-10 et seq.]

(iii) General VPDES Permit for Discharges of Stormwater from Construction Activities (VAR10)

The owner or operator of projects involving land-disturbing activities of equal to or greater than one acre is required to apply for registration coverage under the General Permit for Discharges of Stormwater from Construction Activities and develop a project-specific stormwater pollution prevention plan (SWPPP). Construction activities requiring registration also include land disturbance of less than one acre of total land area that is part of a larger common plan of development or sale if the larger common plan of development will collectively disturb equal to or greater than one acre.

The SWPPP must be prepared prior to submission of the registration statement for coverage under the General Permit. The SWPPP must address water quality and quantity in accordance with the VSMP Permit Regulations.

General information and registration forms for the General Permit are available on Construction General Permit webpage. [Reference: Virginia Stormwater Management Act 62.1-44.15 et seq.; VSMP Permit Regulations 9 VAC 25-880 et seq.]. (Fulcher, Valerie)

Comment: 5(c) Recommendations. DCR recommends the Dominion access the Virginia Flood Risk Information System (VFRIS) to find flood zone information. Local floodplain administrator contact information may be found in DCR's Local Floodplain Management Directory. (Fulcher, Valerie)

Comment: Other VPDES Permitting - The facility has an Individual VPDES Permit (VA0052451) and is subject to the requirements of Section 316(a) and Section 316(b) of the CWA. Any changes to the reactors themselves (e.g. uprates, turbine/blade replacements, etc.) that could have an impact on the thermal component of the discharge may need to be addressed through VPDES permitting for 316(a) purposes. Additionally, any work at the intakes or increase in flows related to reactor changes may need to be addressed through VPDES permitting for 316(b) purposes. (Fulcher, Valerie)

Comment: Stormwater Management Plan. Depending on local requirements, a Stormwater Management (SWM) plan may be required. Local SWM program requirements must be requested through the locality. [Reference: Virginia Stormwater Management Act §62.1-44.15 et seq.; Virginia Stormwater Management (VSMP) Permit Regulations 9VAC25-870-10 et seq.] (Fulcher, Valerie)

Comment: General Permit for Stormwater Discharges from Construction Activities (VAR10). DEQ is responsible for the issuance, denial, revocation, termination and enforcement of the Virginia Stormwater Management Program (VSMP) General Permit for Stormwater Discharges from Construction Activities related to municipal separate storm sewer systems (MS4s) and construction activities for the control of stormwater discharges from MS4s and land disturbing activities under the Virginia Stormwater Management Program. The operator or owner of a construction project involving land-disturbing activities equal to or greater than 1 acre is required to register for coverage under the General Permit for Discharges of Stormwater from Construction Activities and develop a project-specific stormwater pollution prevention plan (SWPPP). The SWPPP must be prepared prior to submission of the registration statement for coverage under the General Permit and the SWPPP must address water quality and quantity in accordance with the VSMP Permit Regulations. (Fulcher, Valerie)

Comment: Water Quality and Wetlands. Measures such as but not limited to Best Management Practices (BMPs) must be taken to avoid and minimize impacts to surface waters during construction activities, including potential water quality impacts resulting from construction site runoff. The disturbance of land and surface waters, which include wetlands, open water, and streams, may require prior approval by DEQ; the U.S. Army Corps of Engineers; the Virginia Marine Resources Commission (VMRC); and/or local government wetlands boards (generally in the northern and piedmont regions of Virginia). The Army Corps of Engineers and DEQ work in conjunction to provide official confirmation of whether there are federal and/or state jurisdictional surface waters that may be impacted by the proposed project. VMRC provides its own review to determine its agency jurisdiction. Review of National Wetland Inventory maps or topographic maps for locating wetlands, open waters, or streams may not be sufficient; there may need to be a site-specific review by a qualified professional. If construction activities will occur in or along any streams (perennial, intermittent, or ephemeral), open water or wetlands, the applicant should contact the DEQ- VWP managers at our Northern Virginia Regional Office to determine the need for any permits prior to commencing work that could impact surface waters. DEQ's permit need decisions neither replace nor supersede requirements set forth by other local, state, federal, and Tribal laws, nor eliminate the need to obtain additional permits, approvals, consultations, or authorizations as required by law before proposed activities may commence.

Recommendations

Based upon review of the information provided by the NRC, we offer the following recommendations:

1. Prior to commencing project work, all wetlands and streams within the project corridor should be field delineated and verified by the U.S. Army Corps of Engineers (the Corps), using accepted methods and procedures.
2. Wetland and stream impacts should be avoided and minimized to the maximum extent practicable. Stream impacts should be minimized or avoided by spanning the transmission line across each stream. No foundations should be placed within streambeds. Where access is required across a wetland, removable mats should be used to reduce compaction and rutting. Towers should be placed avoid wetlands, wherever possible. To the extent where any footings must be installed in wetlands, each footing should occupy the minimum space necessary. When excavation for a structure is necessary in a wetland, excess spoil should not be disposed of in adjacent wetland areas unless authorized by a state or federal wetland permit.
3. If the scope of the project changes, additional review will be necessary by this office.
4. At a minimum, compensation for impacts to State Waters, if necessary, should be in accordance with all applicable state wetland regulations and wetland permit requirements, including the compensation for permanent conversion of forested wetlands to emergent wetlands.
5. Any temporary impacts to surface waters associated with this project should require restoration to pre-existing conditions.

6. No activity may substantially disrupt the movement of aquatic life indigenous to the water body, including those species, which normally migrate through the area, unless the primary purpose of the activity is to impound water. Culverts placed in streams must be installed to maintain low flow conditions. No activity may cause more than minimal adverse effect on navigation. Furthermore, the activity must not impede the passage of normal or expected high flows and the structure or discharge must withstand expected high flows.
7. Erosion and sedimentation controls should be designed in accordance with the Virginia Erosion and Sediment Control Handbook, Third Edition, 1992. These controls should be placed prior to clearing and grading and maintained in good working order to minimize impacts to state waters. These controls should remain in place until the area is stabilized and should then be removed. Any exposed slopes and streambanks should be stabilized immediately upon completion of work in each permitted area. All denuded areas should be properly stabilized in accordance with the Virginia Erosion and Sediment Control Handbook, Third Edition, 1992.
8. No machinery may enter surface waters, unless authorized by a Virginia Water Protection (VWP) permit.
9. Heavy equipment in temporarily impacted surface waters should be placed on mats, geotextile fabric, or other suitable material, to minimize soil disturbance to the maximum extent practicable. Equipment and materials should be removed immediately upon completion of work.
10. Activities should be conducted in accordance with any Time-of-Year restriction(s) as recommended by the Department of Game and Inland Fisheries, the Department of Conservation and Recreation, or the Virginia Marine Resources Commission. The permittee should retain a copy of the agency correspondence concerning the Time-of-Year restriction(s), or the lack thereof, for the duration of the construction phase of the project.
11. All construction, construction access, and demolition activities associated with this project should be accomplished in a manner that minimizes construction materials or waste materials from entering surface waters, unless authorized by a permit. Wet, excess, or waste concrete should be prohibited from entering surface waters.
12. Herbicides used in or around any surface water should be approved for aquatic use by the United States Environmental Protection Agency (EPA) or the U.S. Fish & Wildlife Service. These herbicides should be applied according to label directions by a licensed herbicide applicator. A non-petroleum based surfactant should be used in or around any surface waters.
13. Consider mitigating impacts to forested or converted wetlands by establishing new forested wetlands within the impacted watershed. (Fulcher, Valerie)

Comment: We do not have any significant concerns regarding the surface water intake (cooling water intake) from, and resulting thermal discharge to, Lake Anna, assuming no significant changes are proposed to their operation and all currently required monitoring continues to be performed. However, we will review the 316(b) assessment as part of the VPDES renewal package for this facility and will provide specific comments on this aspect of the project to DEQ VPDES staff once we have had the opportunity to review that information. We typically recommend that to protect resident aquatic species from impingement and entrainment, surface water intakes be fitted with a 1mm mesh screen and that the intake velocity not exceed 0.25 fps. In addition, to ensure continued access to necessary instream habitats by resident aquatic species, we recommend that the intake not withdraw more than 10% instantaneous flow (90 %

flowby). We understand that these standards are not practicable or necessary at every surface water intake to ensure the protection of resources under our jurisdiction. (Fulcher, Valerie)

Comment: Since no new work is proposed over State-owned submerged land, the Virginia Marine Resources Commission (VMRC) has no objections to the renewal of the North Anna Power Station operating licenses for Units 1 and 2. Please be advised that the VMRC, pursuant to §28.2-1200 et seq of the Code of Virginia, has jurisdiction over encroachments in, on, or over the beds of the bays, ocean, rivers, streams, or creeks which are the property of the Commonwealth. Accordingly, if any portion of the subject project involves encroachments channel ward of ordinary high water along non-tidal, natural rivers and streams with a drainage area greater than 5-square miles, a permit may be required from our agency. (Fulcher, Valerie)

Comment: Division of Dam Safety and Floodplain Management

Floodplain Management Program: The National Flood Insurance Program (NFIP) is administered by the Federal Emergency Management Agency (FEMA), and communities who elect to participate in this voluntary program manage and enforce the program on the local level through that community's local floodplain ordinance. Each local floodplain ordinance must comply with the minimum standards of the NFIP, outlined in 44 CFR 60.3; however, local communities may adopt more restrictive requirements in their local floodplain ordinance, such as regulating the 0.2 % annual chance flood zone (Shaded X Zone). All development within a Special Flood Hazard Area (SFHA), as shown on the locality's Flood Insurance Rate Map (FIRM), must be permitted and comply with the requirements of the local floodplain ordinance. (Fulcher, Valerie)

Comment: State Agency Projects Only Executive Order 45, signed by Governor Northam and effective on November 15, 2019, establishes mandatory standards for development of state-owned properties in Flood-Prone Areas, which include Special Flood Hazard Areas, Shaded X Zones, and the Sea Level Rise Inundation Area. These standards shall apply to all state agencies.

1. Development in Special Flood Hazard Areas and Shaded X Zones

A. All development, including buildings, on state-owned property shall comply with the locally adopted floodplain management ordinance of the community in which the state-owned property is located and any flood-related standards identified in the Virginia Uniform Statewide Building Code.

Federal Agency Projects: Only Projects conducted by federal agencies within the SFHA must comply with federal Executive Order 11988: Floodplain Management.

DCR's Floodplain Management Program does not have regulatory authority for projects in the SFHA. The applicant/developer must contact the local floodplain administrator for an official floodplain determination and comply with the community's local floodplain ordinance, including receiving a local permit. Failure to comply with the local floodplain ordinance could result in enforcement action from the locality. For state projects, DCR recommends that compliance documentation be provided prior to the project being funded. For federal projects, the applicant/developer is encouraged [sic] reach out to the local floodplain administrator and comply with the community's local floodplain ordinance.

The remaining DCR divisions have no comments regarding the scope of this project. (Fulcher, Valerie)

Response: The NRC staff acknowledge these recommendations and appreciates the information provided by the VDEQ. As stated in Sections 2.2.1 and 2.2.2 of the draft EIS, Dominion has not proposed any facility modifications, new construction, or major refurbishment activities to support the NRC's proposed action (SLR) and continued operations of North Anna. Table B-2 in Appendix B of the draft EIS summarizes the environmental permits and other regulatory requirements that govern North Anna's operations. As indicated Table B-2 and Section 3.5.1.3 of this draft EIS, North Anna submitted a timely application for renewal of its VPDES Clean Water Act (CWA) permit, and the current permit therefore continues in effect pending administrative action on the permit renewal application. The NRC staff anticipates that most routine operation and maintenance activities would be confined to previously disturbed areas of the site, such as those described in Section 3.2.1 of this draft EIS. If Dominion, as the owner/operator of North Anna, proposes major facility modifications, changes in surface water withdrawals and effluent discharges, or new land-disturbing activities, Dominion would be responsible for obtaining the required permits, licenses, and approvals from the appropriate regulatory authorities. Additionally, if facility modifications are required by other governmental entities that would require Dominion to apply for an operating license amendment from the NRC, the NRC staff would then be required to conduct both a safety and an environmental review of the proposed modifications. These comments provide no new information. No changes were made to the NRC staff's environmental evaluation as a result of these comments.

Comment: DSEIS Section 3.5.1.3, page 3-32, line 3 reflects the following:

"Most notably, North Anna's VDPES permit VA0004090... " The cited permit number seems to conflict with the Environmental Report reference "Dominion. 2006a".

Recommend revising to: "Most notably, North Anna's VDPES permit VA0052541 ... " (Sartain, Mark)

Response: The NRC staff revised the VPDES permit number in Section 3.5.1.3 of the draft EIS for accuracy, as suggested by the commenter.

A.2.5 Groundwater Resources

Comment: Public Water Supply. According to the GEIS Supplement 7 (page 3-120), major water sources for Louisa County and the towns of Louisa and Mineral include Lake Anna, 9 groundwater wells, an irrigation lake on Spring Branch, and the Northeast Creek Reservoir. Louisa County partnered with Fluvanna County to create the James River Water Authority, which has a Virginia Water Protection Permit for withdrawal from the James River. North Anna is not connected to a municipal system and accesses potable water through a series of groundwater wells. While population and water demand are projected to increase during the subsequent license renewal term, existing water sources are expected to meet the increasing needs of the population (GEIS Supplement 7, page 3-124).

11(b) Agency Findings. VDH-ODW finds that NAPS (PWS ID 2109600) has four public groundwater wells (North Anna Nuclear Information Center well and wells 6, 7, and 8) within a 1-mile radius of the project site. There are no surface water intakes for public water supply located within a 5-mile radius of the project site. The project site is within the watershed of the Hanover Suburban Water System (PWS ID 4085398) North Anna River public surface water intake.

11(c) Recommendations. VDH-ODW recommends the following.

Best Management Practices should be employed on the project site, including erosion and sediment controls and Spill Prevention Controls and Countermeasures (SPCC).

Well(s) within a 1,000 foot radius of the project site should be field marked and protected from accidental damage during any future construction. (Fulcher, Valerie)

Comment: Water Conservation. The following recommendations will result in reduced water use associated with the operation of the facility:

- Grounds should be landscaped with hardy native plant species to conserve water as well as lessen the need to use fertilizers and pesticides.
- Convert turf to low water-use landscaping such as drought resistant grass, plants, shrubs and trees.
- Low-flow toilets should be installed in new facilities. Consider installing low flow restrictors and aerators to faucets. Improve irrigation practices by:
    1. upgrading sprinkler clock; water at night, if possible, to reduce evapotranspiration (lawns need only 1 inch of water per week, and do not need to be watered daily; overwatering causes 85% of turf problems);
    2. installing a rain shutoff device; and
    3. collecting rainwater with a rain bucket or cistern system with drip lines.
- Use new high-efficiency washers and dishwashers to reduce water usage by 30-50% per use.
- Check for and repair leaks (toilets and faucets) during regular routine maintenance activities. (Fulcher, Valerie)

Comment: VDH - Office of Drinking Water has reviewed the above project. Below are our comments as they relate to proximity to public drinking water sources (groundwater wells, springs and surface water intakes). Potential impacts to public water distribution systems or sanitary sewage collection systems must be verified by the local utility.

The following public groundwater wells are located within a 1 mile radius of the project site (wells within a 1,000 foot radius are formatted in bold):

- PWS ID Number City/County System Name Facility Name
- 2109600 LOUISA NORTH ANNA POWER STATION WELL 6
- 2109600 LOUISA NORTH ANNA POWER STATION WELL 7
- 2109600 LOUISA NORTH ANNA POWER STATION WELL 8
- 2109610 LOUISA NORTH ANNA NUCLEAR INFORMATION CENTER WELL

There are no surface water intakes located within a 5-mile radius of the project site. The project is within the watershed of the following public surface water sources: PWS ID Number System Name Facility Name 4085398 HANOVER SUBURBAN WATER SYSTEM NORTH ANNA RWI

Best Management Practices should be employed, including Erosion & Sedimentation Controls and Spill Prevention Controls & Countermeasures on the project site.

Well(s) within a 1,000 foot radius from the project site should be field marked and protected from accidental damage during construction. (Fulcher, Valerie)

Response: The NRC staff acknowledges these recommendations and appreciates the information provided by the VDEQ. Dominion will need to comply with applicable VDEQ requirements and continue to implement and maintain soil erosion and sediment controls as well as pollution prevention practices, as cited in Sections 3.4.3 and 3.5.1.3 of the draft EIS, during the North Anna 20 year SLR period. Similarly, as also discussed in Sections 3.4.3, 3.5.1.3, and elsewhere in the draft EIS, Dominion's application of best management practices and implementation of its site stormwater pollution prevention plan would minimize area wide water quality impacts. Sections 3.5.1.2 and 3.5.2.1 describe surface water and groundwater usage, respectively, related to North Anna operations. The NRC staff's analysis discusses the impacts on water resources, including water supply and usage from continued operations of North Anna during the 20-year SLR period. These comments do not provide any significant new information related to the environmental effects of the proposed action. No changes were made to the NRC staff's environmental evaluation as a result of these comments.

Comment: DSEIS Section 3.5.2.2, page 3-37, lines 1-8 reflect the following:

"The North Anna site is in the Virginia Eastern Groundwater Management Area, which comprises all areas east of Interstate 95. In this area, VDEQ requires Groundwater Withdrawal Permits to withdraw more than 300,000 gallons (1.1 million liters (L)) in any month. Permit applications for new groundwater withdrawals or for increases to existing groundwater withdrawals are evaluated for sustainability by considering the combined impacts from all existing lawful withdrawals. Focusing on water quality and supply, the annual State Water Resource Plan (VDEQ 2020d) summarizes water withdrawals and identifies water withdrawal trends Statewide and within the management area." This statement seems to conflict with the Environmental Report Sections E3.1, E3.5, and E3.6.

Recommend removal of these lines, as North Anna is not located in the Virginia Eastern Groundwater Management Area. (Sartain, Mark)

Response: The NRC staff acknowledges that North Anna is not located in the Virginia Eastern Groundwater Management Area. In this draft EIS, the NRC staff has revised/changed the text cited by the commenter in Section 3.5.2.3 of the draft EIS to delete the reference to the Virginia Eastern Groundwater Management Area.

A.2.6 Terrestrial Resources

Comment: Pesticides and Herbicides. DEQ recommends that the use of herbicides or pesticides for construction or landscape maintenance should be in accordance with the principles of integrated pest management. The least toxic pesticides that are effective in controlling the target species should be used to the extent feasible. (Fulcher, Valerie)

Comment: Natural Heritage Resources. The GEIS Supplement 7 (page 3-51) finds that based on a review of Virginia Natural Heritage Program (VNHP) databases, Dominion identified nine state-listed species known to occur or potentially occur in Louisa or Spotsylvania counties. Of these nine state-listed species, six are terrestrial and three are aquatic. The NRC staff concludes that the landscape maintenance activities, stormwater management, elevated noise levels, and other ongoing operations and maintenance activities that Dominion might undertake during the renewal term would primarily be confined to already disturbed areas of the North Anna site. These activities would neither have noticeable effects on terrestrial resources nor would they destabilize any important attribute of the terrestrial resources on or in the vicinity of the North Anna site (GEIS Supplement 7, page 3-54).

9(b) Agency Findings.

(i) Natural Heritage Resources

DCR-DNH searched its Biotics Data System (Biotics) for occurrences of natural heritage resources from the project area. According to the information currently in Biotics, natural heritage resources have not been documented within the project boundary including a 100 foot buffer. The absence of data may indicate that the project area has not been surveyed, rather than confirm that the area lacks natural heritage resources. In addition, the project boundary does not intersect any of the predictive models identifying potential habitat for natural heritage resources.

(ii) State-listed Plant and Insect Species

DCR-DNH finds that the proposed activity will not affect any documented state-listed threatened and endangered plant or insect species.

(iii) State Natural Area Preserves

DCR finds that there are no State Natural Area Preserves under the agency’s jurisdiction in the project vicinity.

9 (c) Recommendation. Contact DCR-DNH to secure updated information on natural heritage resources if the scope of the project changes and/or six months passes before the project is implemented, since new and updated information is continually added to the Biotics Data System. (Fulcher, Valerie)

Comment: Forest Resources. According to the GEIS Supplement 7 (page 3-105), the proposed action would not involve forest management specifically. However, Dominion would continue to perform vegetation maintenance on the site over the course of the proposed license renewal term. Less-developed areas and forested areas would be largely unaffected during the subsequent license renewal term. Dominion does not intend to expand the existing facilities or otherwise perform construction or maintenance activities within these areas. Site personnel may occasionally remove select trees around the margins of existing forested areas if those trees are deemed hazardous to buildings, infrastructure, or other site facilities or to existing overhead clearances.

12(b) Agency Findings. DOF staff has no comments on the proposed license renewal. (Fulcher, Valerie)

Comment: Division of Natural Heritage

The Department of Conservation and Recreation’s Division of Natural Heritage (DCR) has searched its Biotics Data System for occurrences of natural heritage resources from the area outlined on the submitted map. Natural heritage resources are defined as the habitat of rare, threatened, or endangered plant and animal species, unique or exemplary natural communities, and significant geologic formations. According to the information currently in Biotics, natural heritage resources have not been documented within the submitted project boundary including a 100 foot buffer. The absence of data may indicate that the project area has not been surveyed, rather than confirm that the area lacks natural heritage resources. In addition, the project boundary does not intersect any of the predictive models identifying potential habitat for natural heritage resources. There are no State Natural Area Preserves under DCR's jurisdiction in the project vicinity. Under a Memorandum of Agreement established between the Virginia Department of Agriculture and Consumer Services (VDACS) and the DCR, DCR represents VDACS in comments regarding potential impacts on state-listed threatened and endangered plant and insect species. The current activity will not affect any documented state-listed plants or insects. New and updated information is continually added to Biotics. Please re-submit project information and map for an update on this natural heritage information if the scope of the project changes and/or six months has passed before it is utilized. The Virginia Department of Game and Inland Fisheries (VDGIF) maintains a database of wildlife locations, including threatened and endangered species, trout streams, and anadromous fish waters that may contain information not documented in this letter. Their database may be accessed from http://vafwis.org/fwis/or contact Ernie Aschenbach at 804-367-2733 or Ernie.Aschenbach@dwr.virginia.gov. (Fulcher, Valerie)

Response: These comments refer to Dominion's obligation under State law and regulatory authority. As stated in Sections 2.2.1 and 2.2.2 of the draft EIS, Dominion has not proposed any facility modifications, new construction, or major refurbishment activities to support the NRC's proposed action (SLR) and continued operations of North Anna. Table B-2 in Appendix B of the draft EIS summarizes the environmental permits and other regulatory requirements that govern North Anna's operations. As discussed in the draft EIS (Section 3.6.4), Dominion anticipates that most operation and maintenance activities would be confined to previously disturbed areas of the site. If Dominion proposes major facility modifications or new land—disturbing activities, Dominion would be responsible for obtaining the required approvals from the State and Federal regulatory authorities, as appropriate. Some facility modifications, if proposed, would require an operating license amendment involving NRC safety and environmental review. No changes were made to the NRC staff's environmental evaluation as a result of these comments.

A.2.7 Aquatic Resources

Comment: Wildlife Resources and Protected Species. According to the GEIS Supplement 7 (page 3-51), a review of Department of Wildlife Resources databases identified nine state-listed species known to occur or potentially occur in Louisa or Spotsylvania counties. Of these nine state-listed species, six are terrestrial and three are aquatic. The NRC staff concludes that the landscape maintenance activities, stormwater management, elevated noise levels, and other ongoing operations and maintenance activities that Dominion might undertake during the renewal term would primarily be confined to already disturbed areas of the North Anna site. These activities would neither have noticeable effects on terrestrial resources nor would they destabilize any important attribute of the terrestrial resources on or in the vicinity of the North Anna site (GEIS Supplement 7, page 3-54).

> 10(a) Agency Jurisdiction. The Virginia Department of Wildlife Resources (DWR) (formerly the Department of Game and Inland Fisheries), as the Commonwealth's wildlife and freshwater fish management agency, exercises enforcement and regulatory jurisdiction over wildlife and freshwater fish, including state- or federally-listed

endangered or threatened species, but excluding listed insects (Virginia Code, Title 29.1). DWR is a consulting agency under the U.S. Fish and Wildlife Coordination Act (16 U.S. Code §661 et seq.) and provides environmental analysis of projects or permit applications coordinated through DEQ and several other state and federal agencies. DWR determines likely impacts upon fish and wildlife resources and habitat, and recommends appropriate measures to avoid, reduce or compensate for those impacts. For more information, see the DWR website.

10(b) Agency Findings. DWR does not currently document any listed wildlife or designated resources from the project area and has no significant concerns with the relicensing of NAPS Units 1 and 2. In addition, DWR does not have any significant concerns regarding the surface water intake (i.e., cooling water withdrawal) from Lake Anna, and the resulting thermal discharge back to the lake, assuming no significant changes are proposed to its operation and all currently required monitoring continues to be performed. DWR will review future CWA 316(b) assessments as part of NAPS VPDES renewal package and will provide specific comments on this aspect of the project to DEQ VPDES staff once DWR has had the opportunity to review the information.

10(c) Recommendations.

(i) Comprehensive Aquatic Vegetation Management Plan

DWR recommends the development and implementation of a Comprehensive Aquatic Vegetation Management Plan for Lake Anna, in cooperation with DWR. The plan should address issues such as management of emergent vegetation, submerged aquatic vegetation, and algae (particularly harmful algal blooms) in a manner that results in a healthy aquatic ecosystem. The cooperative development of the plan should be coordinated with DWR, John Odenkirk, Regional Aquatic Biologist at (504) 899-4169 or john.odenkirk@dwr.virginia.gov.

(ii) Protection of Aquatic Species

DWR typically recommends that surface water intakes be fitted with a 1mm mesh screen and that the intake velocity not exceed 0.25 fps to protect resident aquatic species from impingement and entrainment. In addition, the intake should not withdraw more than 10% instantaneous flow (90% flowby) to ensure continued access to necessary instream habitats by resident aquatic species. However, DWR understands that these standards are not practicable or necessary at every surface water intake to ensure the protection of resources under its jurisdiction. (Fulcher, Valerie)

Comment: We do not currently document any listed wildlife or designated resources from the project area. We have no significant concerns with the relicensing of NAPS Units 1 and 2, however we do recommend the development of a Comprehensive Aquatic Vegetation Management Plan for Lake Anna. We recommend that such a plan be developed and implemented in cooperation with DWR. This plan could address issues such as management of emergent vegetation, submerged aquatic vegetation, and algae (particularly harmful algal blooms) in a manner that results in a healthy aquatic ecosystem. We recommend coordination with John Odenkirk, DWR Regional Aquatic Biologist, at 504-899-4169 or John.Odenkirk@DWR.virginia.gov regarding cooperative development of such a plan for Lake Anna. (Fulcher, Valerie)

Comment: EPA recognizes the National Pollutant Discharge Elimination System (NPDES) permitting authority, Virginia Department of Environmental Quality (VDEQ), has made an impingement best technology available (BTA) determination under CWA Section 316 (b) in accordance with the current regulations at 40 CFR 122 and 40 CFR 125, issued in 2014, and that the facility has implemented any associated requirements. EPA notes that VADEQ has not made an entrainment BTA determination for North Anna. Compliance with the permitted BTA does not eclipse the NRC and Dominion's responsibility under the NEPA to evaluate in the DSEIS appropriate mitigation measures to avoid or minimize adverse environmental impacts of the action, even if the impacts are deemed small or minimal. Mitigation of these impacts includes reducing or eliminating an impact over time or compensating for an impact by replacing or providing substitute resources or environments. A NPDES permit does not shield Dominion from conducting a complete NEPA evaluation of impacts and adopting further mitigation measures. The DSEIS states that the area of impingement is an extremely small percentage of Lake Anna (less than 0.001 percent of the lake's total surface area). Collectively, the information indicates that impingement is unlikely to cause noticeable or detectable impacts on Lake Anna's aquatic populations. Even though the adverse effect of the Area of Influence may be considered small; Dominion should consider approaches to further reduce the effects of impingement. EPA recommends a fish return system be installed at the cooling water intake structure to reduce the North Anna's impact on the aquatic community. As stated in the study, EPA has found that impingement mortality is typically less than 100 percent if the cooling water intake system includes fish return or backwash systems. The DSEIS states that the Commonwealth of Virginia is considering two entrainment reduction methods to reduce the adverse effects of the facility. The study notes that an estimated 68,564,980 fish are entrained per season. Although the DSEIS states that the number is small compared to the total number of estimated fish in Lake Anna, EPA recommends Dominion implement both seasonal flow reductions and the installation of the 2-mm fish mesh screens. (Gillespie, Joy)

Response: The NRC staff acknowledges the Virginia Department of Wildlife Services' recommendation for Dominion to develop a Comprehensive Aquatic Vegetation Management Plan in cooperation with the State. The draft EIS describes several ongoing efforts to manage or control aquatic vegetation in Lake Anna. For instance, Section 3.4.1 of the draft EIS describes sampling plans conducted in Lake Anna by Dominion and the State to monitor cyanobacteria concentrations and issue public health advisories, as necessary. Section 3.7.1.3 of the draft EIS describes Dominion's invasive species management plans, which were developed in coordination with local stakeholders and agencies. These plans address hydrilla and Asian clams, among other invasive species. No changes were made to the NRC staff's environmental evaluation as a result of these comments.

In its comments concerning impingement and entrainment, the EPA recommends that Dominion install a fish return system and implement seasonal flow reductions and 2-mm mesh screens. In conducting its NEPA reviews, the NRC staff relies on the expertise and authority of the National Pollutant Discharge Elimination System (NPDES) permitting authority when evaluating the impacts of impingement and entrainment. If the NPDES permitting authority has made BTA determinations for a facility under CWA Section 316(b) in accordance with the current regulations at 40 CFR Part 122-TN2769, "EPA Administered Permit Programs: the National Pollutant Discharge Elimination System," and 40 CFR Part 125-TN254 "Criteria and Standards for the National Pollutant Discharge Elimination System," and that facility has implemented any associated requirements, the NRC staff presumes that adverse impacts on the aquatic environment will be minimized or regulated by the cognizant regulatory authority. Accordingly, the NRC staff concludes that the impacts of either impingement, entrainment, or both, would be SMALL for the proposed license renewal term (i.e., impacts would not be detectable or would be so minor that they would neither destabilize nor noticeably alter any important attribute of the resource).

With respect to the impacts of impingement from North Anna, the VDEQ has determined that North Anna meets the criteria for a closed-cycle recirculating water system for purposes of CWA Section 316(b) compliance and has, therefore, implemented impingement mortality BTA. Because of this determination, the NRC staff finds in Section 3.7.3.1 of the draft EIS that the adverse impacts associated with impingement at North Anna would be SMALL and that further mitigation need not be considered. With respect to the impacts of entrainment, the VDEQ has not made a BTA determination. However, Dominion has analyzed two entrainment reduction methods (seasonal flow reductions and installation of 2-mm fine-mesh screens) and submitted associated information to the VDEQ about the feasibility and effectiveness of these strategies. In Section 3.7.3.1 of the draft EIS, the NRC staff describes these methods and the potential for each method to reduce entrainment. The NRC staff also considers several other lines of evidence as part of its entrainment analysis, including the results of entrainment studies and calculations of the entrainment area of influence. Based on this information, the NRC staff concludes that the impacts of entrainment would be SMALL and that any further mitigation that may be imposed in a future VPDES permit once VDEQ makes an entrainment BTA determination would further reduce these SMALL impacts. The NRC staff acknowledges the EPA’s recommendations, and notes that the VDEQ is the responsible regulatory agency with authority to institute or require mitigation measures concerning entrainment. VDEQ may impose such mitigation measures upon making an entrainment BTA determination. No changes were made to the NRC staffs environmental evaluation as a result of these comments.

Comment: EPA recommends the DSEIS clarify how the waste heat treatment facility (WHTF) lagoons are constructed and configured at the site. A detailed schematic would be useful to better understand how the WHTFs interact with the reservoir and how flow moves through the interconnected lagoons to the reservoir. A map provided (Figure 3-1 Major Surface Water Features Associated with the Lake Anna Watershed) appears to show the three WHTF lagoons are part of Lake Anna with each lagoon located on separate tributaries to the North Anna River (Elk Creek, WHTF Lagoon 1; Millpond Creek, WHTF Lagoon 2; and Coleman Creek, WHTF Lagoon 3); however, there appears to be no discussion regarding these tributaries and the lagoons relationship the lake is not clearly defined. If the tributaries flow into the WHTFs, disconnecting the tributaries and the associated aquatic communities from the Lake Anna and the North Anna River, EPA recommends an analysis be conducted on the impact these facilities have on the tributaries' aquatic organisms and ecosystem including appropriate mitigation analysis. (Gillespie, Joy)

Response: The commenter correctly notes that the waste heat treatment facility (WHTF) lagoons are hydrologically connected to several creeks (Elk, Millpond, and Coleman Creeks, as depicted in draft EIS Figure 3-1). In EIS Section 3.7.3.2, the NRC staff analyzed thermal impacts on aquatic organisms. The staff’s analysis considers all aquatic organisms that may be affected by North Anna’s effluent discharge and not just those organisms that occur within the WHTF itself. In that section, the NRC staff finds that, because the State has granted Dominion multiple, sequential variances under CWA Section 316(a), the adverse impacts on the aquatic environment associated with thermal effluent are minimized. With respect to other potential impacts of the proposed SLR, aquatic organisms in Elk, Millpond, and Coleman Creeks would not be susceptible to impingement or entrainment because the cooling water intake system draws from the main portion of the Lake Anna reservoir. The NRC staff added language in Section 3.7.3.2, clarifying that due to the direction of discharge flow, thermal effluent would not impact aquatic organisms in certain creeks that are hydrologically connected to the WHTF.

A.2.8 Historic and Cultural Resources

Comment: The Cherokee Nation recently received a review request for the North Anna Power Station, Unit Nos. 1 and 2, located in Louisa and Spotsylvania Counties, Virginia. These aforementioned counties are outside the Cherokee Nation's Area of Interest. Thus, this Office respectfully defers to federally recognized Tribes that have an interest in this land base at this time. (Toombs, Elizabeth)

Response: The NRC acknowledges this comment that Louisa and Spotsylvania Counties are outside the Cherokee Nation's Area of Interest. No changes were made to the NRC staff's environmental evaluation as a result of these comments.

A.2.9 Human Health

Comment: DSEIS Section 3.11.3, page 3-133, lines 26-27 reflect the following:

"The CDC, VDH, and Dominion report no occurrences of N. fowleri human infection in Lake Anna since the amoeba was identified in 1972." The cited year (1972) seems to conflict with the Environmental Report Section E3.10.1.

Recommend revising to:

"The CDC, VDH, and Dominion report no occurrences of N. fowleri human infection in Lake Anna since the amoeba was identified in 1978." (Sartain, Mark)

Response: The NRC staff has revised the date in Section 3.11.3, as recommended by the commenter.

A.2.10 Environmental Justice

Comment: EPA recognizes that the NRC has conducted EJ-focused analyses to avoid, minimize, and/or mitigate disparate impacts among local communities. To support these efforts, EPA recommends the use of the EJSCREEN tool. EJSCREEN is a publicly accessible online mapping system that combines environmental and demographic data to enable analyses of populations who may experience adverse environmental impacts. In addition to data concerning communities of color and low-income populations, the tool provides demographic data regarding linguistic isolation, education, and age, all of which may enhance EJ-related analyses and outreach. The EJSCREEN tool is available at https://www.epa.gov/ejscreen. (Gillespie, Joy)

Comment: EPA encourages the NRC to conduct (or continue to advance) community outreach for meaningful public engagement and participation, particularly with low income, minority and/or linguistically isolated communities in the study area. EPA encourages the NRC to provide notices of public meetings, notices of informational events, and/or other related resources at frequently visited community locations. These locations may include, but may not be limited to, schools, faith centers, community centers, barbershops, salons, and medical centers. These efforts should be documented in the FSEIS. (Gillespie, Joy)

Response: The NRC staff conducted its environmental justice review in accordance with guidance contained in the Commission's Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions (69 FR 52040; TN1009) and in Appendix D of NRC office instruction LIC-203 (ADAMS Accession No. ML20016A379; NRC

2020-TN6399). In accordance with the NRC's policy statement and guidance, minority and low-income populations are identified when the minority and/or low-income population of an impacted area exceeds 50 percent, or the minority and/or low-income population is meaningfully greater than the minority and/or low-income population percentage within a 50-mi (80-km) radius of the nuclear power site. In this draft EIS, the NRC staff determined that the meaningfully greater analysis is appropriate, because it allows for the environmental justice analysis to focus on the potential effects occurring where the concentration of minority or low-income populations is greatest compared to the geographic area (50-mi [80-km] radius). Draft EIS Figure 3-7 and Figure 3-8 are geographic information maps that visually present the locations of minority and low-income populations within the 50-mi (80-km) radius of the facility using 2010 U.S. Census data and American Community Survey data. Additionally, draft EIS Section 3.10 describes socioeconomic factors and characteristics, including regional employment, income, unemployment, migrant workers, housing, and local public services. While the environmental justice analysis did not apply the Geographic Information System mapping tool, EJSCREEN, the locations and concentration of minority and low-income populations presented in Section 3.12 and Figure 3-7 and Figure 3-8 are generally comparable to EJSCREEN.

Consistent with established NRC practice, notices regarding the SLR application, other matters, and public meetings were published in the *Federal Register*. As part of its outreach efforts, the NRC publicized the scoping and DSEIS public meetings in the local newspaper, The Central Virginian. Additionally, copies of the SLR application and the DSEIS were sent to and were available at the Louisa County Public Library. No changes were made to the NRC staff's environmental evaluation as a result of these comments.

A.2.11 Postulated Accidents and Severe Accident Mitigation Alternatives (SAMAs)

Comment: DSEIS Section F.3.2, page F-8, lines 24-28 reflect the following:

"The fire and seismic CDFs (3.9x10-5 per reactor-year and 6x10-6 per reactor-year, respectively) for North Anna as well as the sum of the two, were less than 5.9x10-5 per reactor-year. This value (5.9x10-5) was the internal events mean value CDF for PWRs that the 2013 GEIS used to estimate probability- weighted, offsite consequences from airborne, surface water, and groundwater pathways, as well as the resulting economic impacts from such pathways." The cited values of 3.9E-5 and 6E-6 for North Anna fire and seismic core damage frequencies (CDFs), respectively, appear to conflict with the Environmental Report Table E4.15-2. There is no fire CDF value provided in the Environmental Report and the seismic CDF referenced in the Environmental Report is 6E-5.

Recommend revising to:

"A combined fire and seismic external hazards value would be expected to be in the range of the internal event CDFs provided in the 2013 GEIS. Similarly, the estimated probability - weighted, offsite consequences from airborne, surface water, and groundwater pathways, as well as the resulting economic impacts from such pathways would be expected to be consistent with the 2013 GEIS." (Sartain, Mark)

Comment: DSEIS Section F.3.9, page F-13, Line 30 reflects the following:

"... small North Anna LERF value of 2.49 × 10^{-6}/year demonstrates that the risk of early and latent ... " The value of 2.49 × 10^{-6}/year seems to conflict with Environmental Report Table E4.15-2.

Recommend revising to:

".. . small North Anna LERF value of 1.72E-7/year demonstrates that the risk of early and latent... " (Sartain, Mark)

Comment: DSEIS Section F.5.4, page F-20, lines 27-29 reflect the following:

"Of the results presented in Table E4.15-2, one case (case name labeled as "EDG") yielded an internal events LERF reduction of 57 percent." The use of the acronym "LERF [large early release frequency]" seems to conflict with the Environmental Report Section E4.15.4.3.

Recommend revising to:

"Of the results presented in Table E4.15-2, one case (case name labeled as "EDG") yielded an internal events LLRF reduction of 57 percent." (Sartain, Mark)

Response: The NRC staff agreed with the recommendations and made changes to Appendix F accordingly.

A.2.12 Waste Management

Radioactive Waste

Comment: An updated plan for the safe storage of the increasing radioactive waste stored at the North Anna power station, for subsequent license renewal. (J. Cruickshank, M Pillow, B. Hodsdon, J. Surr, D. Shaunesey, W. Johnson, ucanmailjackie@yahoo.com, D. Erwin, P. Gordon, K. Johnson, A. Schefer, Danielle Schefer, Denise Schefer).

Response: As discussed in draft EIS Section 2.1.4.4, “Radioactive Waste Storage,” Dominion stores spent nuclear fuel from Units 1 and 2 in a storage pool and in an onsite independent spent fuel storage installation (ISFSI). As indicated in Section 2.1.4.4, the ISFSI contains three separate spent fuel storage pads, each of which can accommodate 28 concrete-and-steel storage casks, for a total of 84 casks. The ISFSI operates under a separate license covering the three dry storage pads. It is possible that North Anna may need to expand the existing capacity of the North Anna ISFSI if the U.S. Department of Energy has not begun taking possession of the spent nuclear fuel when all available ISFSI storage space is filled. This would require North Anna to construct a new ISFSI pad to accommodate additional spent nuclear fuel generated during the SLR term. Alternatively, North Anna may choose to use a higher density storage system to create additional storage capacity and, thereby, reduce the need to expand the ISFSI. At this time, North Anna has not yet determined whether to expand the ISFSI. Dominion (VEPCO 2020-TN8099) has not proposed the installation of additional spent fuel storage pads in the current ISFSI area to support SLR and it is unknown at this time whether additional ISFSI storage pads will need to be, or will be built. Therefore, in the absence of further information, the staff does not see the need for an updated radioactive waste storage plan at this time and does not consider an expansion of the ISFSI in this draft EIS. The NRC staff notes, however, that NRC oversight of onsite spent fuel storage ensures that increases in onsite storage can be safely accommodated with little environmental effect. Further, the impacts of onsite storage of spent nuclear fuel during the period of extended operation have been determined to be SMALL, as stated in 10 CFR Part 51, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions,” Appendix B, “Environmental Effect of Renewing the Operating License of a Nuclear Power Plant, Table B 1, “Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants”; see also, NUREG-2157, “Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel” (NRC 2014-TN4117) (environmental impacts of spent fuel storage beyond the licensed life of reactor operations). The comment contains no new or significant information. No changes were made to the NRC staff’s environmental evaluation as a result of this comment. Nonradioactive Waste

Comment: 7(b) Agency Findings. DEQ-DLPR conducted a search of the project area of solid and hazardous waste databases (including petroleum releases) to identify waste sites in close proximity (200-foot radius) to the NAPS site. The search did not identify any waste sites which might impact the future projects.

7(c) Requirements.

(i) Solid and Hazardous Waste Management

Any soil, sediment or groundwater that is suspected of contamination or wastes that are generated must be tested and disposed of in accordance with applicable federal, state, and local laws and regulations. All construction waste must be characterized in accordance with the Virginia Hazardous Waste Management Regulations prior to management at an appropriate facility.

(ii) Petroleum Contamination

If evidence of a petroleum release is discovered during construction, it must be reported to DEQ-NRO in accordance with Virginia Code § 62.1-44.34.8 through 9 and 9 VAC 25-580-10 et seq. Petroleum-contaminated soils and groundwater that is generated during project implementation must be characterized and disposed of properly.

(iii) Petroleum Storage Tanks

The removal, relocation or closure of any regulated petroleum storage tanks, either an above-ground storage tank (AST) or an underground storage tank (UST), must be conducted in accordance with the requirements of the Virginia Tank Regulations 9 VAC 25-91-10 et seq. (AST) and/or 9 VAC 25-580-10 et seq. (UST). Documentation must be submitted [to] DEQ-NRO.

The installation and operation of regulated petroleum ASTs or USTs must be conducted in accordance with 9 VAC 25-91-10 et seq. and/or 9 VAC 25-580-10 et seq. Furthermore, the installation and use of ASTs with a capacity of greater than 660 gallons for temporary fuel storage (>120 days) during construction must follow the requirements in 9 VAC 25-91-10 et seq.

(iv) Asbestos-Containing Materials and Lead-Based Paint

All structures being demolished, renovated, or removed should be checked for asbestos-containing materials (ACM) and lead-based paint (LBP) prior to demolition. If ACM or LBP are found, in addition to the federal waste-related regulations mentioned above, state regulations 9 VAC 20-81-620 (ACM) and 9 VAC 20-60-261 (LBP) must be followed.

7(d) Recommendation. DEQ encourages all construction projects and facilities to implement pollution prevention principles, including the reduction, reuse, and recycling of all solid wastes generated. All generation of hazardous wastes should be minimized and handled appropriately. (Fulcher, Valerie)

Comment: Pollution Prevention. DEQ advocates that principles of pollution prevention be used in all construction projects as well as in facility operations. Effective siting, planning, and onsite Best Management Practices (BMPs) will help to ensure that environmental impacts are minimized. However, pollution prevention techniques also include decisions related to construction materials, design, and operational procedures that will facilitate the reduction of wastes at the source.

13(a) Recommendations. We have several pollution prevention recommendations that may be helpful in the construction of this project and in the operation of the facility: Consider development of an effective Environmental Management System (EMS). An effective EMS will ensure that the Army is committed to minimizing its environmental impacts, setting environmental goals, and achieving improvements in its environmental performance. DEQ offers EMS development assistance and it recognizes facilities with effective Environmental Management Systems through its Virginia Environmental Excellence Program. Consider environmental attributes when purchasing materials. For example, the extent of recycled material content, toxicity level, and amount of packaging should be considered and can be specified in purchasing contracts. Consider contractors' commitment to the environment (such as an EMS) when choosing contractors. Specifications regarding raw materials and construction practices can be included in contract documents and requests for proposals. Choose sustainable materials and practices for infrastructure construction and design. These could include asphalt and concrete containing recycled materials, and integrated pest management in landscaping, among other things. Integrate pollution prevention techniques into utility maintenance and operation, to include the following: inventory control (record-keeping and centralized storage for hazardous materials), product substitution (use of non-toxic cleaners), and source reduction (fixing leaks, energy-efficient HVAC and equipment). Maintenance facilities should be designed with sufficient and suitable space to allow for effective inventory control and preventative maintenance.

DEQ's Office of Pollution Prevention provides information and technical assistance relating to pollution prevention techniques and EMS. (Fulcher, Valerie)

Comment: The Division of Land Protection & Revitalization (DLPR) has completed its review of the Nuclear Regulatory Commission's August 27, 2021 EIR for NRC Subsequent License Renewal for North Anna Power Station Units 1 and 2 in Louisa, Virginia. DLPR staff conducted a search (200 ft. radius) of the project area of solid and hazardous waste databases (including petroleum releases) to identify waste sites in close proximity to the project area. DLPR search did not identify any waste sites within the project area which might impact the project. DLPR staff has reviewed the submittal and offers the following comments:

Hazardous Waste/RCRA Facilities - none in close proximity to the project area

CERCLA Sites - none in close proximity to the project area

Formerly Used Defense Sites (FUDS) - none in close proximity to the project area.

Solid Waste - none in close proximity to the project area

Virginia Remediation Program (VRP) - none in close proximity to the project area

Petroleum Releases - none in close proximity to the project area (Fulcher, Valerie)

Comment: Soil, Sediment, Groundwater, and Waste Management

Any soil, sediment or groundwater that is suspected of contamination or wastes that are generated must be tested and disposed of in accordance with applicable Federal, State, and local laws and regulations. Some of the applicable state laws and regulations are Virginia Waste Management Act, Code of Virginia Section 10.1-1400 et seq.; Virginia Hazardous Waste Management Regulations (VHWMR) (9VAC 20-60); Virginia Solid Waste Management Regulations (VSWMR) (9VAC 20-81); Virginia Regulations for the Transportation of Hazardous Materials (9VAC 20-110). Some of the applicable Federal laws and regulations are: the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. Section 6901 et seq., and the applicable regulations contained in Title 40 of the Code of Federal Regulations; and the U.S. Department of Transportation Rules for Transportation of Hazardous Materials, 49 CFR Part 107. (Fulcher, Valerie)

Comment: Asbestos and/or Lead-based Paint

All structures being demolished/renovated/removed should be checked for asbestos-containing materials (ACM) and lead-based paint (LBP) prior to demolition. If ACM or LBP are found, in addition to the federal waste-related regulations mentioned above, State regulations 9 VAC 20-81-620 for ACM and 9 VAC 20-60-261 for LBP must be followed. Questions may be directed to Richard Doucette at the DEQ's Northern Regional Office at (703) 583-3800. (Fulcher, Valerie)

Comment: Pollution Prevention - Reuse - Recycling

Please note that DEQ encourages all construction projects and facilities to implement pollution prevention principles, including the reduction, reuse, and recycling of all solid wastes generated. All generation of hazardous wastes should be minimized and handled appropriately. (Fulcher, Valerie)

Comment: Land Protection Division - The project manager is reminded that if any solid or hazardous waste is generated/encountered during construction or operation, the project manager would follow applicable federal, state, and local regulations for their disposal. (Fulcher, Valerie)

Response: Waste minimization and pollution prevention are important elements of operations at all nuclear power plants. As discussed in Section 3.13.2 of the draft EIS, licensees are required to consider pollution prevention measures as dictated by the Pollution Prevention Act (Public Law 101 5084; TN6607) and the Resource Conservation and Recovery Act of 1976, as amended (Public Law 94 580; TN1281).

The Resource Conservation and Recovery Act governs the disposal of solid waste. VDEQ, the Virginia Waste Management Board, and EPA regulate solid and hazardous waste in Virginia. As described in Section 2.1.5, “Nonradioactive Waste Management System,” North Anna has a nonradioactive waste management program to handle nonradioactive waste in accordance with Federal, State, and corporate regulations and procedures. North Anna maintains a waste minimization program that uses material control, process control, waste management, recycling, and feedback to reduce waste.

The North Anna stormwater pollution prevention plan identifies potential sources of pollution that may affect the quality of stormwater discharges from permitted outfalls. The stormwater pollution prevention plan also describes BMPs for reducing pollutants in stormwater discharges and assuring compliance with the site's NPDES permit.

North Anna also has an environmental management system (VEPCO 2020-TN8099). Procedures are in place to monitor areas within the site that have the potential to discharge oil into or upon navigable waters, in accordance with the regulations in 40 CFR Part 112-TN1041,40 CFR Part 112-TN1041, "Oil Pollution Prevention." The Pollution Incident/Hazardous Substance Spill Procedure identifies and describes the procedures, materials, equipment, and facilities that Dominion uses to minimize the frequency and severity of oil spills at North Anna. The comments contain no new or significant information. No changes were made to the NRC staff's environmental evaluation as a result of these comments.

A.2.13 License Renewal Process and NEPA

Comment Summary: These comments express concerns about the adequacy of the NRC's license renewal processes and associated regulations. Examples include: (a) concern that the application is premature (nearly 20 years before current license expires), (b) concern that the NRC needs to prepare a new site-specific EIS instead of a supplemental EIS to the license renewal generic EIS, (c) concern that there is a need for a new SAMA analysis from the applicant in the ER, (d) concern that the NRC's regulations regarding the use of the license renewal generic EIS and the NRC consideration of SAMA analyses are not applicable for subsequent license renewal, (e) concern that there exist Commissioners' dissenting opinions supporting the view that the use of the license renewal generic EIS does not apply to subsequent license renewal, (f) concern that a full public hearing should be provided for the North Anna SLR application, and (g) concern regarding reopening a previous petition to intervene and a motion to reopen and amend the contention basis that were denied by the ASLB [Atomic Safety and Licensing Board.]. (J. Cruickshank, M. Pillow, A. McKeithen, B. Hodsdon, J. Gillespie, P. Gunter/J. Brancoli, J. Surr, D. Shaunesey, W. Johnson, P. Gordon, K. Johnson, A. Schefer, Danielle Schefer, Denise Schefer, ucanmailjackie@yahoo.com, S. Bannon).

Response: Some of these comments provide information that is similar to or the same as information identified in the scoping summary report and were discussed in Section B.1.7 of that report and in draft EIS Appendix A.1.

The NRC's processes and regulations for license renewal and SLR are well established and have been used in the NRC's consideration of numerous license renewal and SLR applications to date, as listed on the public websites:

https://www.nrc.gov/reactors/operating/licensing/renewal/applications.html

https://www.nrc.gov/reactors/operating/licensing/renewal/subsequent-license-renewal.html

Members of the public who believe that NRC regulations should be amended or rescinded may file a petition for rulemaking in accordance with the provisions of 10 CFR 2.802 (TN6204), "Petition for Rulemaking—Requirements for Filing."

Concerning the license renewal and SLR time frame, 10 CFR 54.17 (TN4878), "Filing of Application," allows applications to be submitted up 20 years before the expiration of the operating license currently in effect. This is because the NRC recognizes it may take 10–14 years for new power plants to be designed and constructed if the existing license is not renewed (see 1991 Final Rule, Nuclear Power Plant License Renewal, 56 FR 64943-TN8654,). Concerning NRC staff's consideration of Severe Accident Mitigation Alternative analyses for SLR of North Anna, the staff's treatment of these matters is consistent with 10 CFR 51.53(c)(3)(ii)(L) (TN250), which states: "If the staff has not previously considered severe accident mitigation alternatives for the applicant's plant in an environmental impact statement or related supplement or in an environmental assessment, a consideration of alternatives to mitigate severe accidents must be provided." The NRC staff has considered North Anna Severe Accident Mitigation Alternatives in the 2002 final SEIS for the initial license renewal of North Anna (NRC 2002-TN8296).

Concerning the commenter's interest in a full public Atomic Safety and Licensing Board hearing for SLR, neither the Commission's regulations nor the Atomic Energy Act or NEPA require that a hearing be held. Rather, Section 189(a) of the Atomic Energy Act requires that an opportunity be provided for persons whose interests may be affected by the proceeding to request a hearing and petition to intervene. The Commission's regulations in 10 CFR 54.27 (TN4878), "Hearings," affords a 60-day period for a request for hearing, consistent with 10 CFR 2.105 (TN6204), "Notice of proposed action," and 10 CFR 2.309 (TN6204), "Hearing requests, petitions to intervene, requirements for standing, and contentions." In accordance with these requirements, for North Anna SLR, the NRC afforded interested members of the public an opportunity to request a hearing and petition to intervene during a 60-day period following publication of the notice in the *Federal Register* (85 FR 65438-TN8292). A request for a hearing and petition for leave to intervene was timely filed by several organizations; after considering responses filed by the applicant and NRC staff, and holding oral argument on the petition, the Atomic Safety and Licensing Board denied the petition for failing to set forth an admissible contention. The petitioners filed an appeal from that decision, as well as a subsequent motion to amend their contention and reopen the proceeding—those matters are pending before the Commission at this time.

Concerning the commenter's interest in reopening the petition to intervene and to amend the contention basis, because the petitioners have filed an appeal and a motion to reopen and amend the contention with the Commission, those adjudicatory issues will be addressed by the Commission as appropriate.

These comments contain no significant new information, as specified in 10 CFR 51.95(c)(3) (TN250). No changes were made to the NRC staff's environmental evaluation as a result of these comments.

A.2.14 General Opposition to or Support of Subsequent License Renewal

Summary of comments: These comments express general opposition to or support of nuclear power and SLR of North Anna Power Station Units 1 and 2. Examples opposing license renewal include: (a) preference for other technologies instead of outdated/aging reactor technology/plants, (b) general concern about nuclear safety including earthquake implication. Examples supporting license renewal include: (a) license renewal is needed for clean energy and grid reliability and analysis is needed for the environmental impacts of not having these benefits from license renewal, (c) North Anna has robust nuclear safety because of significant safety improvement over the past 40 years, (e) North Anna has continued positive impact on the local economy and the well-being of the community, (f) North Anna license renewal has the lowest impacts among the alternatives, (g) North Anna SLR is appropriate because Virginia has neither the solar intensity of the Southwest nor the wind of the Midwest, and (h) safe nuclear power is needed to fight climate change. (J. Cruickshank, D. Berlin, M. Pillow, B. Lankford, J. Brancoli/P. Gunter, P. Gordon, K. Johnson., A. Schefer, Danielle Schefer, Denise Schefer, ucanmailjackie@yahoo.com, E. Hendrixson, G. Woods, J. Lamana, L. Schefer)

Response: These comments provide information that are similar to or the same as information discussed in the scoping summary report, Section B.1.6, and the draft EIS, Appendix A.1. These comments are general in nature and contain no significant new information, as specified in 10 CFR 51.95(c)(3) (TN250). No changes were made to the NRC staff's environmental evaluation as a result of these comments.

A.2.15 Outside of Scope—Operational Safety Issues, Safety Concerns, Dam Safety, and Chernobyl Concerns

Summary of Comments: These comments express concerns about North Anna current operational safety issues or material aging management programs. Examples of current operational safety issue comments include those about: (a) upgrade of equipment, structures, and components to withstand future earthquakes and (b) climate change adaptation. Examples of material aging management review comments (safety concerns) include those about: (a) the need for a robust aging management review using results from harvesting and lab testing of aged materials from decommissioned reactors. Several commenters also expressed safety concerns about: North Anna Dam safety as related to radiological hazard and implications related to the 1986 Chernobyl incident in the former Soviet Union (J. Cruickshank, M. Pillow, A. McKeithen, D. Erwin, B. Hodsdon, J. Surr, D. Shaunesey, W. Johnson, ucanmailjackie@yahoo.com, L. Schefer).

Response: These comments provide information that is similar to or the same as information discussed in the scoping summary report, Sections B.1. and B.2, and the draft EIS Appendix A.1. These comments are beyond the scope of the environmental review and contain no significant new information, as specified in 10 CFR 51.95(c)(3) (TN250). No changes were made to the NRC staff's environmental evaluation as a result of these comments.

Regarding current North Anna operational safety issues and NRC oversight of current operations, the NRC addresses operational safety issues as part of its ongoing regulatory oversight of North Anna to ensure continued safe operation. Additional information is available at:

https://www.nrc.gov/reactors/operating/oversight.html

https://www.nrc.gov/reactors/operating/oversight/docket-chart.html?docket=na1

Regarding the August 23, 2011, Central Virginia (Mineral) earthquake, additional information is available in the report "Technical Evaluation Related to Plant Restart after the Occurrence of an Earthquake Exceeding the Level of the Operating Basis and Design Basis Earthquakes" (ADAMS Accession No. ML11308B406 NRC 2011-TN8494).

Regarding the NRC staff's aging management review, the staff issued its final "Safety Evaluation Report Related to the Subsequent License Renewal Application of North Anna Power Station, Units 1 and 2," in January 2022. The complete safety review information is available at:

https://www.nrc.gov/reactors/operating/licensing/renewal/applications/north-anna-1-2-subsequent.html

Regarding design-basis accidents, the staff anticipates minimal or no change in the impacts of those accidents during the subsequent period of extended operations, based on the adequacy of the current licensing basis (10 CFR 54.3(a), "Definitions") as enhanced by the licensee's aging management reviews, under 10 CFR 54.29 (TN4878), "Standards for issuance of a renewed license" and 10 CFR 54.30 (TN4878), "Matters not subject to a renewed review." This is supported and strengthened by (a) the NRC Reactor Oversight Program that incorporates operating experience from domestic and international data and (b) the NRC backfit policy allowing the imposition of additional requirements needed for adequate protection (10 CFR 50.109, "Backfitting" TN249). The NRC, supported by the Reactor Oversight Program, has full authority to take all necessary actions to protect public health and safety.

Regarding radiological hazards associated with Lake Anna Dam safety, additional information is available in the NRC staff reports: "North Anna Power Station, Units 1 and 2—Staff Assessment of Response to 10 CFR 50.54(f) (TN249) Information Request—Flood-Causing Mechanism Reevaluation," and "North Anna Power Station, Units 1 and 2—Staff Assessment of Flooding Focused Evaluation" (ADAMS Accession Nos. ML15238A844 NRC 2015-TN8650 and ML17325B644 NRC 2017-TN8652).

Regarding the Chernobyl accident's safety implications, additional information is available in NUREG-1251, Vol. I, "Implications of the Accident at Chernobyl for Safety Regulation of Commercial Nuclear Power Plants in the United States, Final Report" (ADAMS Accession No. ML082030501 NRC 1989-TN8653).

A.2.16 Outside of Scope—Operation Economics

Comment: The Economic costs need to be also evaluated. The cost of construction of the replacement of 1900 MWe (and the cost to the Virginia Rate Payers) needs to be part of the evaluation. North Anna Power Station is a low-cost producer of Electricity. Replacement costs would be 3-5 times higher (or more, if batteries are considered). This will have an adverse impact on the Rate Payers of Virginia. (E. Hendrixson).

Response: The economic costs and benefits of renewing an operating license are outside the scope of the NRC staff's environmental review. The NRC's regulation at 10 CFR 51.95(c)(2) (TN250) states, in part, "The supplemental environmental impact statement for license renewal is not required to include discussion of need for power or the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation…." This comment is beyond the scope of the environmental review and contains no significant new information, as specified in 10 CFR 51.95(c)(3) (TN250). No changes were made to the NRC staff's environmental evaluation as a result of these comments.

A.2.17 Comments Received During the 2022 Scoping Period

Consistent with Commission Legal Issuance (CLI)-22-03 (ADAMS Accession No. ML22055A533 NRC 2022-TN8272), the NRC staff conducted a second limited scoping process in 2022 as part of preparing the draft site-specific EIS. On November 15, 2022, the NRC published in the Federal Register a notice of intent to conduct environmental scoping and prepare a draft EIS (87 FR 68522-TN8588). In this notice, the NRC requested that members of the public and stakeholders submit comments on the North Anna SLR environmental review to the Federal Rulemaking Website at Regulations.gov.

At the conclusion of the 2022 limited scoping period, the staff issued the North Anna Limited Scoping Summary Report dated December 2023 (NRC 2023-TN9555). The report (a) contains comments received through Regulations.gov, (b) groups these comments by subject area, and (c) contains the NRC staff's responses to these comments.

A.3 References

10 CFR Part 2. *Code of Federal Regulations*, Title 10, *Energy*, Part 2, "Rules of Practice for Domestic Licensing Proceedings and Issuance of Orders." TN6204.

10 CFR Part 50. *Code of Federal Regulations*, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities." TN249.

10 CFR Part 51. *Code of Federal Regulations*, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." TN250.

10 CFR Part 54. *Code of Federal Regulations*, Title 10, *Energy*, Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants." TN4878.

40 CFR Part 112. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 112, "Oil Pollution Prevention." TN1041.

40 CFR Part 122. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 122, "EPA Administered Permit Programs: The National Pollutant Discharge Elimination System." TN2769.

40 CFR Part 125. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 125, "Criteria and Standards for the National Pollutant Discharge Elimination System." TN254.

56 FR 64943. December 13, 1991. "Nuclear Power Plant License Renewal." *Federal Register*. NRC (Nuclear Regulatory Commission). TN8654.

69 FR 52040. August 24, 2004. "Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions." *Federal Register*, Nuclear Regulatory Commission. TN1009.

85 FR 65438. October 15, 2020. "Virginia Electric and Power Company; North Anna Power Station, Units 1 and 2." *Federal Register*, Nuclear Regulatory Commission. TN8292.

85 FR 67572. October 23, 2020. "Notice of Intent To Conduct Scoping Process and Prepare Environmental Impact Statement; Virginia Electric and Power Company; North Anna Power Station, Unit Nos. 1 and 2." *Federal Register*, Nuclear Regulatory Commission. TN8294.

86 FR 47525. August 25, 2021. "Virginia Electric and Power Company; Dominion Energy Virginia; North Anna Power Station, Unit Nos. 1 and 2." Federal Register, NRC (Nuclear Regulatory Commission), Washington, D.C. TN8611.

86 FR 48139. August 27, 2021. "Environmental Impact Statements; Notice of Availability." Federal Register, Environmental Protection Agency. TN8610.

87 FR 68522. November 15, 2022. “Notice of Intent to Conduct Scoping Process and Prepare Supplement to Draft Environmental Impact Statement Virginia Electric and Power Company North Anna Power, Units 1 and 2.” *Federal Register*, Nuclear Regulatory Commission. TN8588.

42 U.S.C. § 4321 et seq. U.S. Code Title 41, The Public Health and Welfare, Section 4321 "Congressional Declaration of Purpose.” TN8608.

NRC (U.S. Nuclear Regulatory Commission). 1989. *Implications of the Accident at Chernobyl for Safety Regulation of Commercial Nuclear Power Plants in the United States, Final Report, Main Report*. NUREG-1251, Volume 1, Washington, D.C. ADAMS Accession No. ML082030501. TN8653.

NRC (U.S. Nuclear Regulatory Commission). 2002. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 7: Regarding North Anna Power Station, Units 1 and 2, Final Report.* NUREG-1437, Supplement 7, Washington, D.C. ADAMS Accession Nos. ML023380542 and ML023380567. TN8296.

NRC (Nuclear Regulatory Commission). 2011. *Related to Plant Restart after the Occurrence of an Earthquake Exceeding the Level of the Operating Basis and Design Basis Earthquakes*. Docket Nos. 50-338 and 50-339, Nuclear Regulatory Commission, Washington, D.C. ADAMS Accession No. ML11308B406. TN8494.

NRC (U.S. Nuclear Regulatory Commission). 2014. *Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel.* Final Report, NUREG-2157, Washington, D.C. ADAMS Package Accession No. ML14198A440. TN4117.

NRC (Nuclear Regulatory Commission). 2015. Letter from V. Hall, Senior Project Manager, to D. Heacock, President and Chief Nuclear Officer, dated September 25, 2015, regarding “North Anna Power Station, Units 1 and 2 - Staff Assessment of Response to 10 CFR 50.54(f) Information Request - Flood-Causing Mechanism Reevaluation (TAC Nos. MF1106 and MF1107).” Washington, D.C. ADAMS Accession No. ML15238A844. TN8650.

NRC (Nuclear Regulatory Commission). 2017. Letter from F. Vega, Senior Project Manager, to D. Stoddard, Senior Vice President and Chief Nuclear Officer, dated September 25, 2015, regarding “North Anna Power Station, Units 1 and 2 - Staff Assessment of Flooding Focused Evaluation (CAC Nos. MF9916 and MF9917; EPID L-2017-JLD-0046).” Washington, D.C. ADAMS Accession No. ML17325B644. TN8652.

NRC (U.S. Nuclear Regulatory Commission). 2020. *Procedural Guidance for Preparing Categorical Exclusions, Environmental Assessments, and Considering Environmental Issues*. LIC-203, Revision 4, Washington, D.C. ADAMS Accession No. ML20016A379. TN6399.

NRC (U.S. Nuclear Regulatory Commission). 2021. Letter from R.B. Elliott, Chief, Environmental Review License Renewal Branch, to D.G. Stoddard, Senior Vice President and Chief Nuclear Officer, dated June 30, 2021, regarding “Issuance of Environmental Scoping Summary Report Associated with the NRC Staff’s Review of the North Anna Power Station, Unit Nos. 1 And 2, Subsequent License Renewal Application (EPID NO. L-2020-SLE-0000) (DOCKET: 50-338 AND 50-339).” Washington D.C. ADAMS Accession No. ML21181A127. TN8295.

NRC (U.S. Nuclear Regulatory Commission). 2022. “Memorandum and Order in the Matter of Duke Energy Carolinas, LLC (Oconee Nuclear Station, Units 1, 2,and 3); Exelon Generating Company, LLC (Peach Bottom Atomic Power Station, Units 2 and 3); Florida Power & Light Co. (Turkey Point Nuclear Generating Units 3 and 4); Nextera Energy Point Beach, LLC (Point Beach Nuclear Plant, Units 1 and 2); Virginia Electric and Power Company (North Anna Power Station, Units 1 and 2).” CLI-22-03, Rockville, Maryland. ADAMS Accession Nos. ML22055A521, ML22055A526, ML22055A527, ML22055A533, ML22055A554. TN8272.

NRC (U.S. Nuclear Regulatory Commission). 2023. *Environmental Impact Statement Scoping Process, Summary Report, North Anna Power Station, Units 1 and 2 Louisa County, VA*. Washington D.C. ADAMS Accession No. ML23326A100. TN9555.

Pollution Prevention Act of 1990. 42 U.S.C. § 13101 *et seq*. TN6607.

Resource Conservation and Recovery Act of 1976 (RCRA). 42 U.S.C. § 6901 *et seq*. TN1281.

VEPCO (Virginia Electric and Power Company). 2020. *Appendix E Applicant's Environmental Report Subsequent Operating License Renewal Stage North Anna Power Station Units 1 and 2*. ADAMS Accession No. ML20246G698. TN8099.

APPENDIX B

APPLICABLE LAWS, REGULATIONS, AND OTHER REQUIREMENTS

There are several Federal laws and regulations that affect environmental protection, health, safety, compliance, and consultation at every Nuclear Regulatory Commission (NRC) licensed nuclear power plant. Some of these laws and regulations require permits by or consultations with other Federal agencies or State, Tribal, or local governments. Certain Federal environmental requirements have been delegated to State authorities for enforcement and implementation. Furthermore, States have also enacted laws to protect public health and safety and the environment. It is the NRC's policy to make sure nuclear power plants are operated in a manner that provides adequate protection of public health and safety and protection of the environment through compliance with applicable Federal and State laws, regulations, and other requirements, as appropriate.

The Atomic Energy Act of 1954, as amended (AEA) (42 U.S.C. 2011 et seq.), authorizes the NRC to enter into an agreement with any State that allows the State to assume regulatory authority for certain activities (see 42 U.S.C. 2021). A State that enters into such an agreement with the NRC is called an Agreement State. Virginia is one such NRC Agreement State. In the Commonwealth of Virginia, the Virginia Department of Health's (VDH) Division of Radiological Health has regulatory responsibility over certain byproduct, source, and quantities of special nuclear materials not sufficient to form a nuclear critical mass. The Virginia Department of Emergency Management (VDEM) maintains a Radiological Emergency Planning and Response Program to provide response capabilities to radiological accidents or emergencies at the commercial nuclear power plants in and near the Commonwealth of Virginia.

In addition to carrying out some Federal programs, State legislatures develop their own laws. State statutes can supplement, as well as implement, Federal laws for protection of air, surface water, and groundwater. State legislation may address solid waste management programs, locally rare or endangered species, and historic and cultural resources.

The U.S. Environmental Protection Agency (EPA) has the primary responsibility to administer the Clean Water Act (CWA) (33 U.S.C. 1251 et seq). The National Pollutant Discharge Elimination System (NPDES) program addresses water pollution by regulating the discharge of potential pollutants to waters of the United States. As administered by EPA, the CWA allows for primary enforcement and administration through State agencies, as long as the State program is at least as stringent as the Federal program.

The EPA has delegated the authority to issue NPDES permits to the Commonwealth of Virginia, which uses the terminology Virginia Pollutant Discharge Elimination System (VPDES) permits. The Virginia Department of Environmental Quality provides oversight for public water supplies, provides permits to regulate the discharge of industrial and municipal wastewaters—including discharges to groundwater—and monitors State water resources for water quality.

B.1 Federal and State Requirements

North Anna Power Station, Units 1 and 2 (North Anna) is subject to various Federal and State requirements. Table B-1 lists the principal Federal and State regulations and laws that are used or mentioned in this supplemental environmental impact statement for North Anna.

Table B-1 Federal and State Requirements

Law or Regulation	Requirements
License Renewal and Subsequent License Renewal	
Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.)	The AEA and the Energy Reorganization Act of 1974 (42 U.S.C. 5801 et seq.) give the NRC the licensing and regulatory authority for commercial nuclear energy use. They allow the NRC to establish dose and concentration limits for protection of workers and the public for activities under NRC jurisdiction. The NRC implements its responsibilities under the AEA through regulations set forth in Title 10, “Energy,” of the U.S. *Code of Federal Regulations* (CFR).
Archeological and Historic Preservation Act of 1974, as amended (54 U.S.C. § 312501 et seq.)	The Archeological and Historic Preservation Act establishes procedures for preserving historical and archaeological resources. Analysis of environmental compliance included assessing the energy alternatives for possible impacts on prehistoric, historic, and traditional cultural resources.
Antiquities Act of 1906, as amended (54 U.S.C. §§ 320301–320303 and 18 U.S.C. § 1866(b))	The Antiquities Act protects historic and prehistoric ruins, monuments, and antiquities, including paleontological resources, on Federally controlled lands from appropriation, excavation, injury, and destruction without permission.
American Indian Religious Freedom Act of 1978 (42 U.S.C. § 1996)	The American Indian Religious Freedom Act protects Native Americans’ rights of freedom to believe, express, and exercise traditional religions.
Bald and Golden Eagle Protection Act of 1940, as amended (16 U.S.C. §§ 668–668d)	The Bald and Golden Eagle Protection Act makes it unlawful to take, pursue, molest, or disturb bald and golden eagles, their nests, or their eggs anywhere in the United States. The U.S. Fish and Wildlife Service (FWS) may issue take permits to individuals, government agencies, or other organizations to authorize limited, non-purposeful disturbance of eagles, in the course of conducting lawful activities such as operating utilities or conducting scientific research.
Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. § 3001)	The Native American Graves Protection and Repatriation Act establishes provisions for the treatment of inadvertent discoveries of Indian remains and cultural objects. When discoveries are made during ground-disturbing activities, the activity in the area must immediately stop, and reasonable protective efforts, proper notifications, and appropriate disposition of the discovered items must be pursued.

Table B-1 Federal and State Requirements (Continued)

Law or Regulation	Requirements
Comprehensive Environmental Response, Compensation, and Liability Act as amended by the Superfund Amendments and Reauthorization Act (42 U.S.C. § 9601 et seq.)	The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) includes an emergency response program to respond to a release of a hazardous substance to the environment. Releases of source, byproduct, or special nuclear material from a nuclear incident are excluded from CERCLA requirements if the releases are subject to the financial protection requirements of the AEA. CERCLA is intended to provide a response to, and cleanup of, environmental problems that are not covered adequately by the permit programs of the many other environmental laws, including the Clean Air Act (CAA), CWA, Safe Drinking Water Act, Marine Protection, Research, and Sanctuaries Act (33 U.S.C. § 1401 et seq.), Resource Conservation and Recovery Act, and AEA. Under Section 120 of CERCLA, each department, agency, and instrumentality (e.g., a municipality) of the United States is subject to, and must comply with, CERCLA in the same manner as any nongovernmental entity (except for requirements for bonding, insurance, financial responsibility, or applicable time period). Under CERCLA, the EPA would have the authority to regulate hazardous substances at a facility in the event of a release or a "substantial threat of a release" of those materials. Releases greater than reportable quantities would be reported to the National Response Center. Assessment of alternatives for environmental compliance includes consideration of whether hazardous substances, in reportable quantity amounts, could be present at power plants during the license renewal term.
Emergency Planning and Community Right-to-Know Act of 1986 (42 U.S.C. § 11001 et seq.) (also known as "SARA Title III")	The Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA), which is the major amendment to CERCLA (42 U.S.C. § 9601 et seq.), establishes the requirements for Federal, State, and local governments, Indian Tribes, and industry regarding emergency planning and "Community Right-to-Know" reporting on hazardous and toxic chemicals. The "Community Right-to-Know" provisions increase the public's knowledge of and access to information about chemicals at individual facilities, their uses, and releases into the environment. States and communities working with facilities can use the information to improve chemical safety and protect public health and the environment. This Act requires emergency planning and notice to communities and government agencies concerning the presence and release of specific chemicals. The EPA implements this Act under regulations found in 40 CFR Part 355, Part 370, and Part 372.
Pollution Prevention Act of 1990 (42 U.S.C. § 13101 et seq.)	The Pollution Prevention Act establishes a national policy for waste management and pollution control that focuses first on source reduction, then on environmental issues, safe recycling, treatment, and disposal.
National Environmental Policy Act of 1969, 42 U.S.C. 4321 et seq.	The National Environmental Policy Act (NEPA) requires Federal agencies to integrate environmental values into their decision-making process by considering the environmental impacts of proposed Federal actions and reasonable alternatives to those actions. NEPA establishes policy, sets goals (in Section 101), and provides means (in Section 102) for carrying out the policy. Section 102(2) contains action-forcing provisions to ensure that Federal agencies follow the letter and spirit of the Act. For major Federal actions significantly affecting the quality of the human environment, Section 102(2)(c) of NEPA requires Federal agencies to prepare a detailed statement that includes the environmental impacts of the proposed action and other specified information. This environmental impact statement (EIS) has been prepared in accordance with NEPA requirements and NRC regulations (10 CFR Part 51) for implementing NEPA to ensure compliance with Section 102(2).

Table B-1 Federal and State Requirements (Continued)

Law or Regulation	Requirements
10 CFR Part 20	Regulations in 10 CFR Part 20, "Standards for Protection Against Radiation," establish standards for protection against ionizing radiation resulting from activities conducted under licenses issued by the NRC. These regulations are issued under the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974, as amended. The purpose of these regulations is to control the receipt, possession, use, transfer, and disposal of licensed material by any licensee in such a manner that the total dose to an individual (including doses resulting from licensed and unlicensed radioactive material and from radiation sources other than background radiation) does not exceed the standards for protection against radiation prescribed in the regulations in this part.
10 CFR Part 50	Regulations in 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," are NRC regulations issued under the AEA, as amended, and Title II of the Energy Reorganization Act of 1974, to provide for the licensing of production and utilization facilities, including power reactors.
10 CFR Part 51	Regulations in 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," contain the NRC's regulations that implement NEPA.
10 CFR Part 54	NRC regulations in 10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," govern the issuance of renewed operating licenses and renewed combined licenses for nuclear power plants licensed under Sections 103 or 104b of the AEA, as amended, and Title II of the Energy Reorganization Act of 1974. The regulations focus on managing adverse effects of aging. The rule is intended to ensure that important systems, structures, and components will continue to perform their intended functions during the period of extended operation.
Air Quality Protection	
Clean Air Act, 42 U.S.C. 7401 et seq.	The CAA is intended to "protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population." The CAA establishes regulations to ensure maintenance of air quality standards and authorizes individual States to manage permits. Section 118 of the CAA requires each Federal agency, with jurisdiction over properties or facilities engaged in any activity that might result in the discharge of air pollutants, to comply with all Federal, State, inter-State, and local requirements regarding the control and abatement of air pollution. Section 109 of the CAA directs the EPA to set National Ambient Air Quality Standards for criteria pollutants. The EPA has identified and set National Ambient Air Quality Standards such standards for the following criteria pollutants: particulate matter, sulfur dioxide, carbon monoxide, ozone, nitrogen dioxide, and lead. Section 111 of the CAA requires the establishment of national performance standards for new or modified stationary sources of atmospheric pollutants. Section 160 of the CAA requires that specific emission increases must be evaluated before permit approval to prevent significant deterioration of air quality. Section 112 requires specific standards for release of hazardous air pollutants (including radionuclides). These standards are implemented through plans developed by each State and approved by the EPA. The CAA requires sources to meet standards and obtain permits to satisfy those standards. Nuclear power plants may be required to comply with the CAA Title V, Sections 501–507, for sources subject to new source performance standards or sources subject to National

Table B-1 Federal and State Requirements (Continued)

Law or Regulation	Requirements
	Emission Standards for Hazardous Air Pollutants. The EPA regulates the emissions of air pollutants using 40 CFR Parts 50 to 99.
Occupational Safety and Health Act of 1970 (29 U.S.C. § 651 et seq.)	The Occupational Safety and Health Act establishes standards to enhance safe and healthy working conditions in places of employment throughout the United States. The Act is administered and enforced by the Occupational Safety and Health Administration (OSHA), a U.S. Department of Labor agency. Employers who fail to comply with OSHA standards can be penalized by the Federal Government. The Act allows States to develop and enforce OSHA standards if such programs have been approved by the Secretary of Labor.
Noise Control Act of 1972 (42 U.S.C. § 4901 et seq.)	The Noise Control Act delegates the responsibility of noise control to State and local governments. Commercial facilities are required to comply with Federal, State, inter-State, and local requirements regarding noise control. Section 4 of the Noise Control Act directs Federal agencies to carry out programs in their jurisdictions "to the fullest extent within their authority" and in a manner that furthers a national policy of promoting an environment free from noise that jeopardizes health and welfare.
Water Resources Protection	
Clean Water Act (33 U.S.C. § 1251 et seq.)	The CWA; (formerly the Federal Water Pollution Control Act) was enacted to restore and maintain the chemical, physical, and biological integrity of the Nation's water. The Act requires all branches of the Federal Government, with jurisdiction over properties or facilities engaged in any activity that might result in a discharge or runoff of pollutants to surface waters, to comply with Federal, State, inter-State, and local requirements. As authorized by the CWA, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. The NPDES program requires all facilities that discharge pollutants from any point source into waters of the United States to obtain a NPDES permit. A NPDES permit is developed with two levels of controls: technology-based limits and water quality-based limits. NPDES permit terms may not exceed 5 years, and the applicant must reapply at least 180 days prior to the permit expiration date. A nuclear power plant may also participate in the NPDES General Permit for Industrial Stormwater due to stormwater runoff from industrial or commercial facilities to waters of the United States. The EPA is authorized under the CWA to directly implement the NPDES program; however, the EPA has authorized many States to implement all or parts of the national program. Section 316(a) of the CWA addresses thermal effects and requires that facilities operate under effluents limitations that assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the receiving body of water. Section 316(b) of the CWA requires that cooling-water intake structures of regulated facilities must reflect the best technology available for minimizing impingement mortality and entrainment of aquatic organisms. These sections of the CWA are implemented and enforced through the NPDES program. Section 401 of the CWA requires States to certify that the permitted discharge would comply with all limitations necessary to meet established State water quality standards, treatment standards, or schedule of compliance. Under this section, the EPA or a delegated State agency has the authority to review and approve, condition, or deny all permits or licenses that might result in a discharge to waters of the State, including wetlands. CWA Section 401 [33 U.S.C. 1341(a)(1)] states:

Table B-1 Federal and State Requirements (Continued)

Law or Regulation	Requirements
	"No license or permit shall be granted until the certification required by this section has been obtained or has been waived as provided in the preceding sentence. No license or permit shall be granted if certification has been denied by the State, interstate agency, or the administrator, as the case may be." *Therefore, the NRC cannot issue its license without a Section 401 Certification or an NRC determination that a waiver has occurred, in accordance with 40 CFR Part 121.9(c). I*n accordance with 10 CFR 50.54(aa), conditions in the Section 401 Certification become a condition of the NRC's license. The U.S. Army Corps of Engineers (USACE) is the lead agency for enforcement of CWA wetland requirements (33 CFR Part 320). A Section 404 permit would need to be obtained from the USACE before implementing any action, such as earthmoving activities and certain erosion controls, which could disturb wetlands. Federal and State permits/certifications are obtained using the same form and permit applications for activities affecting waterways and wetlands and are reviewed by the USACE in consultation with the FWS, the Soil Conservation Service, the EPA, and the delegated State agency.
Coastal Zone Management Act of 1972, as amended (16 U.S.C. 1451 et seq.)	Congress enacted the Coastal Zone Management Act (CZMA) in 1972 to address the increasing pressures of over-development upon the nation's coastal resources. The National Oceanic and Atmospheric Administration administers the Act. The CZMA encourages States to preserve, protect, develop, and, where possible, restore or enhance valuable natural coastal resources such as wetlands, floodplains, estuaries, beaches, dunes, barrier islands, and coral reefs, as well as the fish and wildlife using those habitats. Participation by States is voluntary. To encourage States to participate, the CZMA makes Federal financial assistance available to any coastal State or territory, including those on the Great Lakes that are willing to develop and implement a comprehensive coastal management program. Section 307(c)(3)(A) of the CZMA requires that applicants for Federal licenses who conduct activities in a coastal zone provide certification that the proposed activity complies with the enforceable policies of the State's coastal zone program. NRC cannot issue its license without CZMA compliance by the applicant.
Safe Drinking Water Act of 1974 (42 U.S.C. § 300(f) et seq.)	The Safe Drinking Water Act (SDWA) was enacted to protect the quality of public water supplies and sources of drinking water and establishes minimum national standards for public water supply systems in the form of maximum contaminant levels for pollutants, including radionuclides. Other programs established by the SDWA include the Sole Source Aquifer Program, the Wellhead Protection Program, and the Underground Injection Control Program. In addition, the Act provides underground sources of drinking water with protection from contaminated releases and spills. If a nuclear power plant is located within an area designated as a sole source aquifer pursuant to Section 1424(e) of the SDWA, the supplemental environmental impact statement would be subject to the EPA review. If the EPA review raises concerns that plant operations are not protective of groundwater quality, specific mitigation recommendations or additional pollution prevention requirements may be required.
Rivers and Harbors Act of 1899, Section 10 (33 U.S.C. § 401 et seq.)	The Rivers and Harbors Act of 1899 (33 U.S.C. § 401 et seq.) requires USACE authorization in order to protect navigable waters in the development of harbors and other construction and excavation. Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 403) prohibits the unauthorized obstruction or alteration of any navigable water of the United States. That

Table B-1 Federal and State Requirements (Continued)

Law or Regulation	Requirements
	section provides that the construction of any structure in or over any navigable water of the United States, or the accomplishment of any other work affecting the course, location, condition, or physical capacity of such waters is unlawful unless the work has been authorized by the Secretary of the Army through the USACE. Activities requiring Section 10 permits include structures (e.g., piers, wharves, breakwaters, bulkheads, jetties, weirs, transmission lines) and work such as dredging or disposal of dredged material, or excavation, filling, or other modifications to the navigable waters of the United States.
Wild and Scenic Rivers Act, 16 U.S.C. 1271 et seq.	The Wild and Scenic Rivers Act created the National Wild and Scenic Rivers System, which was established to protect the environmental values of free-flowing streams from degradation by impacting activities, including water resources projects.
Virginia Administrative Code (VAC), Title 9, "Environment": Agency 15, "Department of Environmental Quality" and Agency 25, "State Water Control Board"	Establishes the Commonwealth of Virginia's rules and regulations related to water quality and supply (Code of Virginia, Title 62.1, "Waters of the State, Ports and Harbors," Chapter 3.1, "State Water Control Law").
VAC, Title 18, "Professional And Occupational Licensing": Agency 160, "Board For Waterworks And Wastewater Works Operators And Onsite Sewage System Professionals"	Establishes the Commonwealth of Virginia's rules and regulations related to wastewater works and onsite sewage system professionals (Code of Virginia, Title 54.1, "Professional and Occupations," Subtitle II, "Professional and Occupations Regulated by the Department of Professional and Occupational Regulation and Boards within the Department," Chapter 23, "Waterworks and Wastewater Works Operators").
VAC, Title 4, "Conservation And Natural Resources": Agency 20, "Marine Resources Commission"	Establishes the Commonwealth of Virginia's rules and regulations related to fisheries and habitat of the tidal waters (Code of Virginia, Title 28.2, "Fisheries and Habitat of the Tidal Waters," Subtitle III, "Habitat," Chapters 12-14, "Submerged Lands," "Wetlands," and "Coastal Primary Sand Dunes and Beaches," respectively).
Waste Management and Pollution Prevention	
Resource Conservation and Recovery Act, 42 U.S.C. 6901 et seq.	The Resource Conservation and Recovery Act (RCRA) requires the EPA to define and identify hazardous waste; establish standards for its transportation, treatment, storage, and disposal; and require permits for persons engaged in hazardous waste activities. Section 3006 (42 U.S.C. 6926) allows States to establish and administer these permit programs with the EPA approval. The EPA regulations implementing the RCRA are found in 40 CFR Parts 260 through 283. Regulations imposed on a generator or on a treatment, storage, and/or disposal facility vary according to the type and quantity of material or waste generated, treated, stored, and/or disposed. The method of treatment, storage, and/or disposal also affects the extent and complexity of the requirements.
VAC 33: Title 9, Agency 15, Chapter 3.1. State Water Control Law	Virginia Department of Environmental Quality (DEQ) is authorized to implement a variety of laws and regulations pertaining to water quality and supply.

Table B-1 Federal and State Requirements (Continued)

Law or Regulation	Requirements
Nuclear Waste Policy Act of 1982 (42 U.S.C. § 10101 et seq.)	The Nuclear Waste Policy Act provides for the research and development of repositories for the disposal of high-level radioactive waste, spent nuclear fuel, and low-level radioactive waste. Title I includes the provisions for the disposal and storage of high-level radioactive waste and spent nuclear fuel. Subtitle A of Title I delineates the requirements for site characterization and construction of the repository and the participation of States and other local governments in the selection process. Subtitles B, C, and D of Title I deal with the specific issues for interim storage, monitored retrievable storage, and low-level radioactive waste.
Low-Level Radioactive Waste Policy Act of 1980, as amended (42 U.S.C. § 2021b et seq.)	The Low-Level Radioactive Waste Policy Act amended the AEA to improve the procedures for the implementation of compacts providing for the establishment and operation of regional low-level radioactive waste disposal facilities. It also allows Congress to grant consent for certain inter-State compacts. The amended Act sets forth the responsibilities for disposal of low-level waste by States or inter-State compacts. The Act states the amount of waste that certain low-level waste recipients can receive over a set time period. The amount of low-level radioactive waste generated by both pressurized and boiling water reactor types is allocated over a transition period until a local waste facility becomes operational.
Hazardous Materials Transportation Act, as amended (49 U.S.C. § 5101 et seq.)	The Hazardous Materials Transportation Act regulates the transportation of hazardous material (including radioactive material) in and between states. According to the Act, States may regulate the transport of hazardous material as long as their regulation is consistent with the Act or the U.S. Department of Transportation regulations provided in 49 CFR Parts 171-177-TN5466. Other regulations regarding packaging for transportation of radionuclides are contained in 49 CFR Part 173-TN298.
Protected Species	
Endangered Species Act, 16 U.S.C. 1531 et seq.	The Endangered Species Act was enacted to prevent the further decline of endangered and threatened species and to restore those species and their critical habitat s. Section 7, "Interagency Cooperation," of the Act requires Federal agencies to consult with the FWS or the National Marine Fisheries Service (NMFS) on Federal actions that may affect listed species or designated critical habitats.
Fish and Wildlife Coordination Act of 1934, as amended (16 U.S.C. §§ 661–666e)	The Fish and Wildlife Coordination Act requires Federal agencies that construct, license, or permit water resource development projects to consult with the FWS (or NMFS, when applicable) and State wildlife resource agencies for any project that involves an impoundment of more than 10 ac (4 ha), diversion, channel deepening, or other water body modification regarding the impacts of that action on fish and wildlife and any mitigative measures to reduce adverse impacts.
Fish and Wildlife Conservation Act of 1980 (16 U.S.C. § 2901 et seq.)	The Fish and Wildlife Conservation Act provides Federal technical and financial assistance to States for the development of conservation plans and programs for nongame fish and wildlife. The Fish and Wildlife Conservation Act conservation plans identify significant problems that may adversely affect nongame fish and wildlife species and their habitats and appropriate conservation actions to protect the identified species. The Act also encourages Federal agencies to conserve and promote the conservation of nongame fish and wildlife and their habitats.

Table B-1 Federal and State Requirements (Continued)

Law or Regulation	Requirements
Magnuson–Stevens Fishery Conservation and Management Act, 16 U.S.C. 1801 et seq.	The Magnuson–Stevens Fishery Conservation and Management Act, as amended, governs marine fisheries management in U.S. Federal waters. The Act created eight regional fishery management councils and includes measures to rebuild overfished fisheries, protect essential fish habitat, and reduce bycatch. Under Section 305 of the Act, Federal agencies are required to consult with the NMFS for any Federal actions that may adversely affect essential fish habitat.
National Marine Sanctuaries Act of 1966, as amended (16 U.S.C. § 1431 et seq.)	The National Marine Sanctuaries Act (NMSA) establishes provisions for the designation and protection of marine areas that have special national significance. The NMSA authorizes the Secretary of Commerce to designate national marine sanctuaries and establish the National Marine Sanctuary System. Pursuant to Section 304(d) of the NMSA, Federal agencies must consult with the National Oceanic and Atmospheric Administration's Office of National Marine Sanctuaries when their proposed actions are likely to destroy, cause the loss of, or injure a sanctuary resource.
Toxic Substances Control Act (15 U.S.C. § 2601 et seq.)	The Toxic Substances Control Act (TSCA) regulates the manufacture, processing, distribution, and use of certain chemicals not regulated by RCRA or other statutes, including asbestos-containing material and polychlorinated biphenyls. Any TSCA-regulated waste removed from structures (e.g., polychlorinated biphenyls-contaminated capacitors or asbestos) or discovered during the implementation phase (e.g., contaminated media) would be managed in compliance with TSCA requirements in 40 CFR Part 761-TN6610
Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. § 703 et seq.)	The Migratory Bird Treaty Act is intended to protect birds that have common migration patterns between the United States and Canada, Mexico, Japan, and Russia. The Act stipulates that, except as permitted by regulations, it is unlawful at any time, by any means, or in any manner to pursue, hunt, take, capture, or kill any migratory bird.
Marine Mammal Protection Act of 1972 (16 U.S.C. § 1361 et seq.)	The Marine Mammal Protection Act (MMPA) was enacted to protect and manage marine mammals and their products (e.g., the use of hides and meat). The primary authority for implementing the Act belongs to the FWS and NMFS. The FWS manages walruses, polar bears, sea otters, dugongs, marine otters, and the West Indian, Amazonian, and West African manatees. The NMFS manages whales, porpoises, seals, and sea lions. The two agencies may issue permits under MMPA Section 104 (16 U.S.C. 1374) to persons, including Federal agencies, that authorize the taking or importing of specific species of marine mammals. After the Secretary of the Interior or the Secretary of Commerce approves a State's program, the State can take over responsibility for managing one or more marine mammals. The MMPA also established a Marine Mammal Commission whose duties include reviewing laws and international conventions related to marine mammals, studying the condition of these mammals, and recommending steps to Federal officials (e.g., listing a species as endangered) that should be taken to protect marine mammals. Federal agencies are directed by MMPA Section 205 (16 U.S.C. 1405) to cooperate with the Commission by permitting it to use their facilities or services.

Table B-1 Federal and State Requirements (Continued)

Law or Regulation	Requirements
Environmental Standards for Uranium Fuel Cycle (40 CFR Part 190, Subpart B)	These regulations establish maximum doses to the body or organs of members of the public as a result of normal operational releases from uranium fuel cycle activities, including uranium enrichment. These regulations were promulgated by the EPA under the authority of the AEA, as amended, and have been incorporated by reference in the NRC regulations in 10 CFR 20.1301(e).
Historic Preservation and Cultural Resources	
National Historic Preservation Act, 54 U.S.C. 300101 et seq. (formerly 16 U.S.C. 470 et seq.)	The National Historic Preservation Act was enacted to create a national historic preservation program, including the National Register of Historic Places and the Advisory Council on Historic Preservation. Section 106 of the Act requires Federal agencies to take into account the effects of their undertakings on historic properties. The Advisory Council on Historic Preservation regulations implementing Section 106 of the Act are found in 36 CFR Part 800, "Protection of Historic Properties." The regulations call for public involvement in the Section 106 consultation process, including involvement from Indian Tribes and other interested members of the public, as applicable.

ac = acers; AEA = Atomic Energy Act; CAA = Clean Air Act; CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act; CFR = *U.S. Code of Federal Regulations*; CZMA = Coastal Zone Management Act; DEQ = Department of Environmental Quality; EIS = environmental impact statement; EPA = U.S. Environmental Protection Agency; EPCRA = Emergency Planning and Community Right-to-Know Act; FWS = U.S. Fish and Wildlife Service; ha = hectares; NEPA = National Environmental Policy Act; NMFS = National Marine Fisheries Service; NMSA = National Marine Sanctuaries Act; NPDES = National Pollutant Discharge Elimination System; NRC = U.S. Code of Federal Regulations; OSHA = Occupational Safety and Health Administration; RCRA = Resource Conservation and Recovery Act; SDWA = Safe Drinking Water Act; TSCA = Toxic Substances Control Act; USACE = U.S. Army Corps of Engineers; VAC = Virginia Administrative Code

B.2 Operating Permits and Other Requirements

Table B-2 lists the permits and licenses issued by Federal, State, and local authorities for operational activities at North Anna, as identified in Chapter 9 of Dominion's environmental report.

Table B-2 Operating Permits and Other Requirements

Permit	Responsible Agency	Number	Expiration Date	Authorized Activity
Authorization to export low-level waste	Southeast Compact Commission for Low-Level Radioactive Waste Management	None	Updated annually	Export of low-level radioactive waste outside the region
Virginia Pollutant Discharge Elimination System permit (VPDES)	Virginia Department of Environmental Quality (VDEQ)	VA0052451	Administratively continued	Discharge of wastewaters to waters of the State

Table B-2 Operating Permits and Other Requirements (Continued)

Permit	Responsible Agency	Number	Expiration Date	Authorized Activity
Air permit	VDEQ	Registration number: 40726	Operating under a permit shield	Operation of air emission sources (emergency diesel generators)
Hazardous waste transportation/ shipment registration	U.S. Department of Transportation (USDOT)	4929 (issued to Virginia Electric and Power)	None	Hazardous materials shipments
Authorization to operate a wastewater treatment plant	VDEQ	VA0052451-01	n/a	Wastewater treatment plant operating permit
Waterworks operation permit	Virginia Department of Health (VDH)	2109610	n/a	Authorization to operate a non-transient non-community (potable) waterworks
Operating license	NRC	NPF-4 and NPF-7	04/01/2038 and 08/21/2040	Operation of North Anna
Long-term maintenance agreement of storm water management	VDEQ	n/a	n/a	Maintenance of detention basins and Independent Spent Fuel Storage Installation (ISFSI) retention basin
ISFSI Authorization	NRC	SNM-2507	06/30/2058	Operation of a dry storage ISFSI
Registration	EPA	VAD065376279	n/a	Hazardous waste generator registration
Registration	VDEQ	Registration PNA-7, 8, 9, 10, 11	Various	Operation of underground storage tanks
Registration	VDEQ	MB705136-0	03/31/2020	Selective taking of migratory birds
Federal Coastal Zone Management Act Consistency Concurrence	VDEQ	DEQ 19-124F (12/23/2019)	n/a	Needed verification that renewal of operating licenses would be consistent with the Coastal Zone Management program

NRC = U.S. Nuclear Regulatory Commission; USDOT = U.S. Department of Transportation; VDEQ = Virginia Department of Environmental Quality; VDH = Virginia Department of Health; VPDES = Virginia Pollutant Discharge Elimination System permit.
Sources: VEPCO 2020-TN8099; VEPCO 2021-TN8179.

APPENDIX C

CONSULTATION CORRESPONDENCE

C.1 Endangered Species Act Section 7 Consultation

As a Federal agency, the U.S. Nuclear Regulatory Commission (NRC) must comply with the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.; TN1010) (ESA), as part of any action authorized, funded, or carried out by the agency. In this case, the proposed agency action is whether to issue subsequent renewed facility operating licenses for the continued operation of North Anna Power Station, Units 1 and 2 (North Anna). The proposed action would authorize Dominion Energy Virginia (Dominion) to operate North Anna for an additional 20 years beyond the current renewed operating license term. Under Section 7 of the ESA, the NRC must consult with the U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) ("the Services" [collectively] or "Service" [individually]), as appropriate, to ensure that the proposed action is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat.

C.1.1 Federal Agency Obligations under Section 7 of the Endangered Species Act

The ESA and the regulations that implement ESA Section 7 at Title 50 of the *Code of Federal Regulations* (50 CFR Part 402-TN4312) describe the consultation process that Federal agencies must follow in support of agency actions. As part of this process, the Federal agency shall either request that the Services (1) provide a list of any listed or proposed species or designated or proposed critical habitats that may be present in the action area or (2) request that the Services concur with a list of species and critical habitats that the Federal agency has created (50 CFR 402.12(c)). If any such species or critical habitats may be present, the Federal agency prepares a biological assessment to evaluate the potential effects of the action and determine whether the species or critical habitats are likely to be adversely affected by the action (50 CFR 402.12(a); 16 U.S.C. 1536(c)).

Biological assessments are required for any agency action that is a "major construction activity" (50 CFR 402.12(b)). A major construction activity is a construction project or other undertaking having construction-type impacts that is a major Federal action significantly affecting the quality of the human environment under the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.) (NEPA) (51 FR 19926-TN7600). Federal agencies may fulfill their obligations to consult with the Services under ESA Section 7 and to prepare a biological assessment, if required, in conjunction with the interagency cooperation procedures required by other statutes, including NEPA (50 CFR 402.06(a)). In such cases, the Federal agency should include the results of ESA Section 7 consultation(s) in the NEPA document (50 CFR 402.06(b)).

C.1.2 Biological Evaluation

Subsequent license renewal (SLR) does not require the preparation of a biological assessment because it is not a major construction activity. Nonetheless, the NRC staff must consider the impacts of its actions on federally listed species and designated critical habitats. In cases where the staff finds that license renewal "may affect" ESA-protected species or habitats, ESA Section 7 requires the NRC to consult with the relevant Service(s).

To support such consultations, the NRC staff has incorporated its analysis of the potential impacts of the proposed license renewal into Section 3.8 of this environmental impact statement (EIS). The NRC staff refers to its ESA analysis as a "biological evaluation."

The NRC staff structured its evaluation in accordance with the Services' suggested biological assessment contents described at 50 CFR 402.12(f). Section 3.8.1 of this report describes the action area as well as the ESA-protected species and habitats potentially present in the action area. Section 3.8.2 assesses the potential effects of the proposed North Anna SLR on the ESA-protected species and habitats present in the action area and contains the NRC's effect determinations for each of those species and habitat. This section also addresses cumulative effects. Finally, Sections 3.8.3 through 3.8.6 address the potential effects of the no-action alternative power replacement alternatives. The results of the NRC staff's analysis are summarized below in Table C-1.

Table C-1 Effect Determinations for Federally Listed Species Under U.S. Fish and Wildlife Service Jurisdiction

Species	Federal Status[(a)]	Potentially Present in the Action Area?	Effect Determination[(b)]	FWS Concurrence Date[(c)]
northern long-eared bat	FE	Yes	NLAA	7/10/23
tricolored bat	FPE	Yes	NLAA	TBD
monarch butterfly	FC	Yes	NLAA	n/a
dwarf wedgemussel	FE	No	NE	n/a
Atlantic pigtoe	FT	No	NE	n/a
green floater	FC	No	NE	n/a
James spineymussel	FE	No	NE	n/a
small whorled pogonia	FT	No	NE	n/a

(a) Indicates protection status under the Endangered Species Act. FC = candidate for Federal listing; FE = federally endangered; FPE = proposed for Federal listing as endangered; FPT = proposed for Federal listing as endangered; and FT = federally threatened.

(b) The NRC staff makes its effect determinations for federally listed species in accordance with the language and definitions specified in the FWS and NMFS Endangered Species Consultation Handbook (FWS and NMFS 1998). NE = no effect; NLAA = May affect but is not likely to adversely affect.

(c) n/a = not applicable; the ESA does not require Federal agencies to seek FWS concurrence for "no effect" determinations or for conclusions regarding effects on candidate species. TBD = to be determined; the NRC will seek the FWS's concurrence following the issuance of this EIS.

C.1.3 Chronology of Endangered Species Act Section 7 Consultation

Endangered Species Act Section 7 Consultation with the U.S. Fish and Wildlife Service

On July 10, 2023, the FWS concurred with the NRC's determination that North Anna SLR may affect but is not likely to adversely affect (NLAA), the northern long-eared bat. Following issuance of this EIS, the NRC staff will seek the FWS's concurrence for additional species for which the NRC determined that the North Anna SLR is NLAA (see Table C-1) in accordance with 50 CFR 402.13(c). Table C-2 lists the correspondence between the NRC and the FWS pursuant to ESA Section 7 that has transpired to date.

Table C-2 Endangered Species Act Section 7 Consultation Correspondence with the U.S. Fish and Wildlife Service

Date	Description	ADAMS Accession No.[(a)]
Oct 26, 2020	Virginia Ecological Services Field Office (FWS) to NRC, Verification letter for the proposed North Anna subsequent license renewal under the January 5, 2016, programmatic biological opinion on final 4(d) rule for northern long-eared bat and activities excepted from take prohibition	ML20300A512
Jan 20, 2021	Virginia Ecological Services Field Office (FWS) to NRC, Updated list of threatened and endangered species for the proposed North Anna subsequent license renewal	ML21021A198
Sept 7, 2021	NRC to FWS, NRC issuance of draft environmental impact statement for North Anna subsequent license renewal, opportunity for public comment, and Endangered Species Act determinations	ML21152A172
July 10, 2023	Virginia Ecological Services Field Office (FWS) to NRC, Updated list of threatened and endangered species for the proposed North Anna subsequent license renewal	ML23191A536
July 10, 2023	Virginia Ecological Services Field Office (FWS) to NRC, Updated concurrence that North Anna SLR is not likely to adversely affect the northern long-eared bat	ML23191A537

(a) Access these documents through the NRC's Agencywide Documents Access and Management System (ADAMS) at http://adams.nrc.gov/wba/.

Endangered Species Act Section 7 Consultation with the National Marine Fisheries Service

As discussed in Section 3.8.1.3 and 3.8.4.2, no federally listed species or critical habitats under NMFS 's jurisdiction occur within the action area. Therefore, the NRC staff did not engage the NMFS pursuant to ESA Section 7 for the proposed North Anna SLR.

C.2 Magnuson–Stevens Act Essential Fish Habitat Consultation

The NRC must comply with the Magnuson–Stevens Fishery Conservation and Management Act of 1996, as amended (16 U.S.C. 1801 et seq.; TN7841), for any actions authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken that may adversely affect any essential fish habitat (EFH) identified under the Magnuson–Stevens Act.

In Sections 3.8.2 and 3.8.4.4 of this EIS, the NRC staff concludes that the NMFS has not designated any EFH under the Magnuson–Stevens Fishery Conservation and Management Act (MSA) in Lake Anna and that the proposed North Anna SLR would have no effect on EFH. Thus, the MSA does not require the NRC to consult with the NMFS for the proposed action.

C.3 National Marine Sanctuaries Act Consultation

The National Marine Sanctuaries Act of 1966, as amended (TN4482), authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archaeological, educational, or aesthetic qualities as national marine sanctuaries. Under Section 304(d) of the act, Federal agencies must consult with the National Oceanic and Atmospheric

Administration's Office of National Marine Sanctuaries if a Federal action is likely to destroy, cause the loss of, or injure any sanctuary resources.

In Sections 3.8.3 and 3.8.4.5 of this EIS, the NRC staff concludes that no coastal or marine waters or Great Lakes occur near North Anna and that the North Annal SLR would have no effect on sanctuary resources. Thus, the NMSA does not require the NRC to consult with National Oceanic and Atmospheric Administration for the proposed action.

C.4 National Historic Preservation Act Section 106 Consultation

The National Historic Preservation Act of 1966, as amended (NHPA, TN4157), requires Federal agencies to consider the effects of their undertakings on historic properties and consult with applicable State and Federal agencies, Tribal groups, individuals, and organizations with a demonstrated interest in the undertaking before taking action. Historic properties are defined as resources that are eligible for listing on the National Register of Historic Places. The historic preservation review process (Section 106 of the NHPA) is outlined in regulations issued by the Advisory Council on Historic Preservation (ACHP) in 36 CFR Part 800-TN513, "Protection of Historic Properties." In accordance with 36 CFR Part 800-TN513.8(c), "Use of the NEPA Process for Section 106 Purposes," the NRC has elected to use the NEPA process to comply with its obligations under Section 106 of the NHPA.

Table C-3 lists the chronology of consultation and consultation documents related to the NRC's NHPA Section 106 review of the North Anna SLR. The NRC staff is required to consult with the noted agencies and organizations in accordance with the statutes listed above.

Table C-3 National Historic Preservation Act Correspondence

Date	Sender and Recipient	Description	ADAMS Accession No.[(a)]
10/30/2020	R. Elliott (NRC) to R. Nelson, Director, Office of Federal Agency Programs, Advisory Council on Historic Preservation	Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20294A420
10/30/2020	R. Elliott (NRC) to J. Langan, State Historic Preservation Officer, Virginia Department of Historic Resources	Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20303A153
10/30/2020	R. Elliott (NRC) to J.R. Johnson, Governor Absentee-Shawnee Tribe	Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20294A491
10/30/2020	R. Elliott (NRC) to W. Harris, Chief Catawba Indian Nation	Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20294A491

Table C-3 National Historic Preservation Act Correspondence (Continued)

Date	Sender and Recipient	Description	ADAMS Accession No.[(a)]
10/30/2020	R. Elliott (NRC) to C. Hoskin, Jr, Principal Chief Cherokee Nation	Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20294A491
10/30/2020	R. Elliott (NRC) to S. Adkins, Chief Chickahominy Indian Tribe	Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20294A491
10/30/2020	R. Elliott (NRC) to G. Steward, Chief Chickahominy Indians – Eastern Division	Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20294A491
10/30/2020	R. Elliott (NRC) to D. Dotson, President Delaware Nation	Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20294A491
10/30/2020	R. Elliott (NRC) to C. Brooks, Chief Delaware Tribe of Indians	Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20294A491
10/30/2020	R. Elliott (NRC) to R. Sneed, Principal Chief Eastern Band of Cherokee Indians	Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20294A491
10/30/2020	R. Elliott (NRC) to G.J. Wallace, Chief Eastern Shawnee Tribe of Oklahoma	Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20294A491
10/30/2020	R. Elliott (NRC) to K. Branham, Tribal Chief Monacan Indian Nation	Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20294A491
10/30/2020	R. Elliott (NRC) to S. Bass, Chief Nansemond Indian Nation	Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20294A491

Table C-3 National Historic Preservation Act Correspondence (Continued)

Date	Sender and Recipient	Description	ADAMS Accession No.[a]
10/30/2020	R. Elliott (NRC) to R. Gray, Chief Pamunkey Indian Tribe	Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20294A491
10/30/2020	R. Elliott (NRC) to G. A. Richardson, Chief Rappahannock Tribe	Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20294A491
10/30/2020	R. Elliott (NRC) to B. Barnes Chief Shawnee Tribe	Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20294A491
10/30/2020	R. Elliott (NRC) to L. Henry, Chief Tuscarora Nation of New York	Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20294A491
10/30/2020	R. Elliott (NRC) to J. Bunch, Chief United Keetoowah Band of Cherokee Indians in Oklahoma	Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20294A491
10/30/2020	R. Elliott (NRC) to W.F. Adams, Chief Upper Mattaponi Indian Tribe	Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20294A491
10/30/2020	R. Elliott (NRC) to W. Brown, Chief Cheroenhaka (Nottoway) Tribe	Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20294A483
10/30/2020	R. Elliott (NRC) to M. Custalow, Chief Mattaponi Tribe	Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20294A483
10/30/2020	R. Elliott (NRC) to J. Caudill, Acting Chief Meherrin Nation	Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20294A483

Table C-3 National Historic Preservation Act Correspondence (Continued)

Date	Sender and Recipient	Description	ADAMS Accession No.[(a)]
10/30/2020	R. Elliott (NRC) to L. Allston, Chief Nottoway Tribe	Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20294A483
10/30/2020	R. Elliott (NRC) to C. Bullock, Chief Patawomeck Tribe	Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20294A483
11/02/2020	B. Obermeyer, Delaware Tribe Historic Preservation Office, to R. Hoffman (NRC)	Response to NRC Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML21132A308
11/17/2020	T. Clouthier, Cultural Resource Director, Pamunkey Indian Tribe, to R. Elliott (NRC)	Response to NRC Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML20329A439
11/20/2020	R. Hoffman (NRC) to T. Clouthier, Cultural Resource Director, Pamunkey Indian Tribe	Email Response and Notification of Site Environmental Audit Session	ML20329A401
11/30/2020	E. Toombs, Tribal Historic Preservation Officer, Cherokee Nation, to R. Hoffman (NRC)	Response to NRC Request for Scoping Comments Concerning the Environmental Review of North Anna Power Station, Units 1 and 2 Subsequent License Renewal Application	ML21132A306
9/14/2021	R. Elliott (NRC) to R. Nelson, Director, Office of Federal Agency Programs, Advisory Council on Historic Preservation	Notice of Availability of the Draft Supplemental Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, for Public Comment	ML21252A033
9/14/2021	R. Elliott (NRC) to J. Langan, State Historic Preservation Officer, Virginia Department of Historic Resources	Notice of Availability of the Draft Supplemental Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, for Public Comment	ML21252A055

Table C-3 National Historic Preservation Act Correspondence (Continued)

Date	Sender and Recipient	Description	ADAMS Accession No.[a]
9/14/2021	R. Elliott (NRC) to J.R. Johnson, Governor Absentee-Shawnee Tribe	Notice of Availability of the Draft Supplemental Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, for Public Comment	ML21252A032
9/14/2021	R. Elliott (NRC) to W. Harris, Chief Catawba Indian Nation	Notice of Availability of the Draft Supplemental Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, for Public Comment	ML21252A032
9/14/2021	R. Elliott (NRC) to C. Hoskin, Jr, Principal Chief Cherokee Nation	Notice of Availability of the Draft Supplemental Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, for Public Comment	ML21252A032
9/14/2021	R. Elliott (NRC) to S. Adkins, Chief Chickahominy Indian Tribe	Notice of Availability of the Draft Supplemental Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, for Public Comment	ML21252A032
9/14/2021	R. Elliott (NRC) to G. Steward, Chief Chickahominy Indians – Eastern Division	Notice of Availability of the Draft Supplemental Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, for Public Comment	ML21252A032
9/14/2021	R. Elliott (NRC) to D. Dotson, President Delaware Nation	Notice of Availability of the Draft Supplemental Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, for Public Comment	ML21252A032
9/14/2021	R. Elliott (NRC) to C. Brooks, Chief Delaware Tribe of Indians	Notice of Availability of the Draft Supplemental Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, for Public Comment	ML21252A032
9/14/2021	R. Elliott (NRC) to R. Sneed, Principal Chief Eastern Band of Cherokee Indians	Notice of Availability of the Draft Supplemental Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, for Public Comment	ML21252A032

Table C-3 National Historic Preservation Act Correspondence (Continued)

Date	Sender and Recipient	Description	ADAMS Accession No.[(a)]
9/14/2021	R. Elliott (NRC) to G.J. Wallace, Chief Eastern Shawnee Tribe of Oklahoma	Notice of Availability of the Draft Supplemental Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, for Public Comment	ML21252A032
9/14/2021	R. Elliott (NRC) to K. Branham, Tribal Chief Monacan Indian Nation	Notice of Availability of the Draft Supplemental Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, for Public Comment	ML21252A032
9/14/2021	R. Elliott (NRC) to S. Bass, Chief Nansemond Indian Nation	Notice of Availability of the Draft Supplemental Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, for Public Comment	ML21252A032
9/14/2021	R. Elliott (NRC) to R. Gray, Chief Pamunkey Indian Tribe	Notice of Availability of the Draft Supplemental Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, for Public Comment	ML21252A032
9/14/2021	R. Elliott (NRC) to G. A. Richardson, Chief Rappahannock Tribe	Notice of Availability of the Draft Supplemental Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, for Public Comment	ML21252A032
9/14/2021	R. Elliott (NRC) to B. Barnes Chief Shawnee Tribe	Notice of Availability of the Draft Supplemental Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, for Public Comment	ML21252A032
9/14/2021	R. Elliott (NRC) to L. Henry, Chief Tuscarora Nation of New York	Notice of Availability of the Draft Supplemental Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, for Public Comment	ML21252A032
9/14/2021	R. Elliott (NRC) to J. Bunch, Chief United Keetoowah Band of Cherokee Indians in Oklahoma	Notice of Availability of the Draft Supplemental Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, for Public Comment	ML21252A032

Table C-3 National Historic Preservation Act Correspondence (Continued)

Date	Sender and Recipient	Description	ADAMS Accession No.[a]
9/14/2021	R. Elliott (NRC) to W.F. Adams, Chief Upper Mattaponi Indian Tribe	Notice of Availability of the Draft Supplemental Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, for Public Comment	ML20294A491
9/14/2021	R. Elliott (NRC) to W. Brown, Chief Cheroenhaka (Nottoway) Tribe	Notice of Availability of the Draft Supplemental Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, for Public Comment	ML21252A046
9/14/2021	R. Elliott (NRC) to M. Custalow, Chief Mattaponi Tribe	Notice of Availability of the Draft Supplemental Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, for Public Comment	ML20294A483
9/14/2021	R. Elliott (NRC) to J. Caudill, Acting Chief Meherrin Nation	Notice of Availability of the Draft Supplemental Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, for Public Comment	ML20294A483
9/14/2021	R. Elliott (NRC) to L. Allston, Chief Nottoway Tribe	Notice of Availability of the Draft Supplemental Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, for Public Comment	ML20294A483
9/14/2021	R. Elliott (NRC) to C. Bullock, Chief Patawomeck Tribe	Notice of Availability of the Draft Supplemental Environmental Impact Statement for Subsequent License Renewal of North Anna Power Station, Units 1 and 2, for Public Comment	ML20294A483

(a) Access these documents through the NRC's Agencywide Documents Access and Management System (ADAMS) at https://adams.nrc.gov/wba/.

C.5 References

36 CFR Part 800. *Code of Federal Regulations*, Title 36, *Parks, Forests, and Public Property*, Part 800, "Protection of Historic Properties." TN513.

50 CFR Part 402. *Code of Federal Regulations,* Title 50, *Wildlife and Fisheries*, Part 402, "Interagency Cooperation—Endangered Species Act of 1973, as amended." TN4312.

51 FR 19926. 1986. "Interagency Cooperation - Endangered Species Act of 1973, as amended." Final Rule, *Federal Register*, Fish and Wildlife Service, Interior; National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Commerce. TN7600.

Endangered Species Act of 1973. 16 U.S.C. § 1531 *et seq.* TN1010.

Magnuson Stevens Fishery Conservation and Management Reauthorization Act of 2006. 16 U.S.C. 1801 Note. Public Law 109-479, January 12, 2007, 120 Stat. 3575. TN7841.

National Historic Preservation Act. 54 U.S.C. § 300101 *et seq*. TN4157.

National Marine Sanctuaries Act, as amended. 16 U.S.C. § 1431 *et seq*. TN4482.

APPENDIX D

CHRONOLOGY OF ENVIRONMENTAL REVIEW CORRESPONDENCE

This appendix contains a chronological listing of correspondence between the U.S. Nuclear Regulatory Commission (NRC) staff and external parties as part of the agency's environmental review of the North Anna Power Station, Units 1 and 2 (North Anna) subsequent license renewal (SLR) application. As part of the NRC staff's environmental review of the North Anna SLR application, the staff conducted two environmental scoping processes. This appendix does not include consultation correspondence or comments received during the scoping process. For a list and discussion of consultation correspondence, see Appendix C of this environmental impact statement (EIS). For scoping comments, see Appendix A of this EIS, the initial "Scoping Summary Report" (Agencywide Documents Access and Management System [ADAMS] Accession No. ML21181A1277), and the second "Scoping Summary Report" (ML23326A100). All documents are available electronically from the NRC's Public Electronic Reading Room found at: http://www.nrc.gov/reading-rm.html. From this site, the public can gain access to ADAMS, which provides text and image files of the NRC's public documents. The ADAMS accession number for each document is included in the following table.

Table D-1 lists the environmental review correspondence, by date, beginning with the request by Dominion Energy Virginia (Dominion) for NRC to issue subsequent renewed operating licenses for North Anna.

Table D-1 Environmental Review Correspondence

Date	Correspondence Description	ADAMS Accession Number
08/24/2020	North Anna Power Station, Units 1 and 2 - Application for Subsequent License Renewal	ML20246G696
08/24/2020	North Anna Power Station, Units 1 and 2 - Application for Subsequent Renewed Operating Licenses [transmittal letter]	ML20246G697
08/24/2020	Appendix E: Applicant's Environmental Report Subsequent Operating License Renewal Stage North Anna Power Station Units 1 and 2.	ML20246G698
08/24/2020	Enclosure 3: North Anna Power Station Subsequent License Renewal Application (CD-ROM Titled: "NAPS_SLRA")	ML20246G700
09/17/2020	North Anna SLRA - Receipt and Availability Letter	ML20224A105
09/30/2020	Acceptance of SLR Application	ML20281A622
10/06/2020	North Anna SLRA - Portal Letter	ML20269A465
10/13/2020	North Anna Power Station, Units 1 and 2 – Determination of Acceptability and Sufficiency for Docketing, Proposed Review Schedule, and Opportunity for a Hearing Regarding the Virginia Electric and Power Company's Application for Subsequent License Renewal (EPID Nos. L-2020-SLR-0000 and L-2020-SLE-0000)	ML20258A284
10/15/2020	Press Release-20-049: NRC Accepts Application for Subsequent License Renewal of North Anna Reactors	ML20351A174

Table D-1 Environmental Review Correspondence (Continued)

Date	Correspondence Description	ADAMS Accession Number
10/19/2020	North Anna Power Station, Unit Nos. 1 and 2: Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process (EPID No. L-2020-SLE-0000) - letter to applicant	ML20274A111
10/19/2020	North Anna Power Station, Unit Nos. 1 and 2: Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process (EPID No. L-2020-SLE-0000) - *Federal Register* Notice	ML20274A198
10/23/2020	Press Release-20-052: NRC Seeks Public Comment on Environmental Review Topics for North Anna Subsequent License Renewal	ML20351A177
10/26/2020	FWS to NRC, Verification letter for North Anna SLR under Programmatic Biological Opinion for Northern Long-eared Bat	ML20300A512
10/26/2020	FWS to NRC, North Anna Subsequent License Renewal Updated List of Threatened and Endangered Species That May Occur in Your Proposed Project Location and/or May Be Affected by Your Proposed Project	ML20300A513
10/28/2020	11/04/2020 Environmental Scoping Meeting Related to the North Anna Power Station, Units 1 and 2, Subsequent License Renewal Application	ML20302A036
11/12/2020	Environmental Scoping Meeting Related to the North Anna Power Station, Units 1 and 2, Subsequent License Renewal Application [transcript]	ML20317A206
11/19/2020	License Renewal Environmental Site Audit Plan Regarding the North Anna Power Station, Units 1 and 2, Subsequent License Renewal Application (EPID L-2020-SLE-0000)	ML20322A052
11/20/2020	Email Response to Pamunkey Request re North Anna Scoping	ML20329A401
12/03/2020	11/04/2020 North Anna Scoping Meeting Summary	ML20324A259
12/04/2020	License Renewal Severe Accident Mitigation Alternatives Audit Plan Regarding the North Anna Power Station, Units 1 and 2, Subsequent License Renewal Application (EPID No.: L-2020-SLE-0000) (Docket No.: 50-338 and 50-339)	ML20337A022
12/17/2020	Summary of the Historic and Cultural Resources Environmental Audit Meeting Related to the Review of the Subsequent License Renewal Application for the North Anna Power Station, Units 1 And 2	ML20350B456
12/17/2020	North Anna SLRA SAMA Audit Summary	ML20351A388
01/22/2021	Letter to D. Stoddard - Re., North Anna Power Station, Units 1 and 2, Summary of the Subsequent License Renewal Environmental Audit	ML21025A340
01/29/2021	Request for Additional Information - North Anna Subsequent License Renewal Application Environmental Review (EPID number: L-2020-SLE-0000) (Docket No.: 50-338 and 50-339)	ML21028A390
02/04/2021	North Anna Power Station (North Anna), Units 1 and 2 - Update to Subsequent License Renewal Application (SLRA) Supplement 1	ML21035A303
02/10/2021	North Anna Power Station (North Anna) Units 1 and 2 - Subsequent License Renewal Application (SLRA) Requested Documents in Response to Environmental Audit	ML21033A301

Table D-1 Environmental Review Correspondence (Continued)

Date	Correspondence Description	ADAMS Accession Number
02/11/2021	North Anna Power Station Units 1 And 2 - Subsequent License Renewal Application, Response to NRC Requests for Confirmation of Information for the Environmental Review	ML21042B904
02/22/2021	North Anna Power Station (North Anna), Units 1 and 2 - Subsequent License Renewal Application (SLRA) Environmental Review - Response to NRC Request for Additional Information	ML21053A433
03/17/2021	North Anna Power Station (North Anna), Units 1 and 2 - Subsequent License Renewal Application (SLRA) Additional Document in Response to Environmental Audit Re: Architectural Survey	ML21076B027
06/30/2021	Issuance of Environmental Scoping Summary Report Associated with The NRC Staff's Review of The North Anna Power Station, Unit Nos. 1 And 2, Subsequent License Renewal Application	ML21181A127
09/07/2021	NRC to FWS, NRC Issuance of Draft Environmental Impact Statement for North Anna Subsequent License Renewal, Opportunity for Public Comment, and Endangered Species Act Determinations	ML21152A172
08/19/2021	North Anna Power Station Subsequent License Renewal Draft SEIS NOA FRN	ML21222A163
08/24/2021	North Anna Power Station Subsequent License Renewal Draft SEIS NOA FRN - Letter to the Applicant	ML21222A197
08/31/2021	NUREG-1437 DFC, Supplement 7, Second Renewal “Generic Environmental Impact Statement for License Renewal of Nuclear Plants Supplement 7, Second Renewal Regarding Subsequent License Renewal for North Anna Power Station Units 1 and 2”	ML21228A084
08/27/2021	09/28/2021 Preliminary Results of the NRC Staff's Environmental Review of the North Anna Power Station, Units 1 and 2, Subsequent License Renewal Application	ML21239A008
09/01/2021	Comment (1) of Eric Hendrixson on Virginia Electric and Power Company; Dominion Energy Virginia; North Anna Power Station, Unit Nos. 1 and 2	ML21245A389
09/14/2021	Fed Tribes - Notice of Availability of the North Anna SLR draft SEIS	ML21252A032
09/14/2021	Advisory Council on Historic Preservation - Notice of Availability of the North Anna SLR draft SEIS	ML21252A033
09/14/2021	State Tribe - Notice of Availability of the North Anna SLR draft SEIS	ML21252A046
09/14/2021	SHPO - Notice of Availability of the North Anna SLR draft SEIS	ML21252A055
08/27/2021	News Release-21-033: NRC Seeks Public Comment on Draft Environmental Impact Statement for North Anna Subsequent License Renewal	ML21256A087
09/16/2021	Press Release-21-037: NRC Webinar to Seek Comment on Draft Environmental Statement for North Anna Subsequent License Renewal	ML21259A157
09/16/2021	Comment (2) of Judy Lamana on Virginia Electric and Power Company; Dominion Energy Virginia; North Anna Power Station, Unit Nos.1 and 2	ML21272A352
09/28/2021	2021/09/28 - Comment (1) Email regarding North Anna SLR Draft SEIS	ML21277A137

Table D-1 Environmental Review Correspondence (Continued)

Date	Correspondence Description	ADAMS Accession Number
10/05/2021	2021/10/05 - Comment (2) Email regarding North Anna SLR Draft SEIS	ML21279A018
10/05/2021	2021/10/05 - Comment (3) Email regarding North Anna SLR Draft SEIS	ML21279A019
10/07/2021	North Anna Power Station (North Anna), Units 1 and 2 - Comments on Draft Plant-Specific Supplement 7, Second Renewal to the Generic Environmental Impact Statement for License Renewal of Nuclear Plants regarding Subsequent License Renewal for Facility Operating Licenses NPF-4 and NPF-7	ML21280A357
10/07/2021	2021/10/07 - Comment (4) Email regarding North Anna SLR Draft SEIS	ML21281A022
10/07/2021	2021/10/07 - Comment (5) Email regarding North Anna SLR Draft SEIS	ML21281A023
10/07/2021	2021/10/07 - Comment (6) Email regarding North Anna SLR Draft SEIS	ML21281A025
10/07/2021	Comment (3) of John Surr on Virginia Electric and Power Company; Dominion Energy Virginia; North Anna Power Station, Unit Nos.1 and 2	ML21286A739
10/08/2021	2021/10/08 - Comment (9) Email regarding North Anna SLR Draft SEIS	ML21284A012
10/08/2021	Comment (4) of Donna Shaunesey on Virginia Electric and Power Company; Dominion Energy Virginia; North Anna Power Station, Unit Nos. 1 and 2	ML21286A740
10/09/2021	Comment (5) of William Johnson on Virginia Electric and Power Company; Dominion Energy Virginia; North Anna Power Station, Unit Nos. 1 and 2	ML21286A741
10/09/2021	Comment (6) of Kate Johnson on Notice of Intent to Conduct Scoping Process and Prepare Environmental Impact Statement Virginia Electric and Power Company; North Anna Power Station, Unit Nos. 1 and 2	ML21286A742
10/09/2021	Comment (7) from Sierra Club on Notice of Intent to Conduct Scoping Process and Prepare Environmental Impact Statement Virginia Electric and Power Company; North Anna Power Station, Unit Nos. 1 and 2	ML21286A744
10/09/2021	Comment (8) of Patricia Gordon on Notice of Intent to Conduct Scoping Process and Prepare Environmental Impact Statement; Virginia Electric and Power Company; North Anna Power Station, Unit Nos. 1 and 2	ML21286A745
10/10/2021	2021/10/10 - Comment (7) Email regarding North Anna SLR Draft SEIS	ML21284A010
10/10/2021	2021/10/10 - Comment (8) Email regarding North Anna SLR Draft SEIS	ML21284A011
10/11/2021	Comment (9) of Concerned Citizen on Virginia Electric and Power Company; Dominion Energy Virginia; North Anna Power Station, Unit Nos. 1 and 2	ML21286A746

Table D-1 Environmental Review Correspondence (Continued)

Date	Correspondence Description	ADAMS Accession Number
10/12/2021	2021/10/12 - Comment (10) Email regarding North Anna SLR Draft SEIS	ML21285A308
10/12/2021	2021/10/12 - Comment (11) Email regarding North Anna SLR Draft SEIS	ML21285A323
10/12/2021	Comment (10) on Alex Schefer on Notice of Intent to Conduct Scoping Process and Prepare Environmental Impact Statement; Virginia Electric and Power Company; North Anna Power Station, Unit Nos. 1 and 2	ML21286A747
10/12/2021	Comment (11) of Denise Schefer on Notice of Intent to Conduct Scoping Process and Prepare Environmental Impact Statement Virginia Electric and Power Company; North Anna Power Station, Unit Nos. 1 and 2	ML21286A748
10/12/2021	Comment (12) of Leo J Schefer on Notice of Intent to Conduct Scoping Process and Prepare Environmental Impact Statement; Virginia Electric and Power Company; North Anna Power Station, Unit Nos. 1 and 2	ML21286A749
10/12/2021	Comment (13) of Danielle Schefer on Notice of Intent to Conduct Scoping Process and Prepare Environmental Impact Statement; Virginia Electric and Power Company; North Anna Power Station, Unit Nos. 1 and 2	ML21286A750
10/12/2021	Comment (14) of Sara Bannon on Notice of Intent to Conduct Scoping Process and Prepare Environmental Impact Statement Virginia Electric and Power Company; North Anna Power Station, Unit Nos. 1 and 2	ML21286A751
04/12/2022	North Anna Power Station, Units 1 and 2 - Annual Environmental Operating Report for 2021	ML22119A176
08/11/2022	North Anna Power Station (NAPS), Units 1 and 2 - Subsequent License Renewal Application (SLRA) Second 10 CFR 54.21(b) Annual Amendment	ML22223A145
09/28/2022	North Anna Power Station (NAPS) Units 1 & 2 - Subsequent License Renewal Application, Appendix E Environmental Report Supplement 1	ML22272A041
11/08/2022	Federal Register Notice - Notice of Intent to Prepare EIS and to Conduct EIS Scoping for North Anna Power Station	ML22294A189
11/15/2022	News Release-22-047: NRC to Review North Anna Subsequent License Renewal Report; Seeks Public Input on Environmental Issues	ML22346A052
11/21/2022	2022/11/21 — Comment (1) Email regarding North Anna Suppl Scoping	ML22339A241
12/15/2022	Revision Of Schedule For The Conduct Of Environmental Review Of The North Anna Power Station Subsequent License Renewal Application	ML22346A090
12/15/2022	Comment (1) of Harmon Curran on Notice of Intent To Conduct Scoping Process and Prepare Supplement To Draft Environmental Impact Statement Virginia Electric and Power Company North Anna Power, Units 1 and 2	ML22350A062
03/08/2023	License Renewal Second Environmental Site Audit Plan Regarding The North Anna Power Station, Units 1 And 2, Subsequent License Renewal Application	ML23062A466

Table D-1 Environmental Review Correspondence (Continued)

Date	Correspondence Description	ADAMS Accession Number
04/05/2023	Revision of Schedule for the Environmental Review of the North Anna Power Station, Units 1 and 2, Subsequent License Renewal Application	ML23075A140
04/26/2023	Request For Additional Information - North Anna Subsequent License Renewal Application Environmental Review	ML23081A528
05/16/2023	North Anna, Units 1 and 2, Responses To Request For Additional Information And Request For Confirmation Of Information Regarding Environmental Review Of Subsequent License Renewal Application	ML23136A883
05/30/2023	North Anna Power Station Units 1 and 2 Summary of the 2023 Subsequent License Renewal Environmental Audit (EPID Number L-2020-SLE-0000 Docket Nos 50-338 and 50-339)	ML23135A162
07/10/2023	FWS to NRC, List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project for North Anna Power Station, Units 1 and 2, Subsequent License Renewal	ML23191A536
07/10/2023	FWS to NRC, Federal agency coordination under the Endangered Species Act, Section 7 for 'North Anna Power Station, Units 1 and 2, Subsequent License Renewal' and concurrence with NLAA determination for NLEB	ML23191A537
09/28/2023	North Anna, Units 1 and 2, Subsequent License Renewal Application Third 10 CFR 54.21(b) Annual Amendment	ML23275A099
10/16/2023	Revision of Schedule for the Environmental Review of the North Anna Power Station Units 1 and 2, Subsequent License Renewal (EPID Number L-2020-SLE-0000 Docket Nos 50-338 and 50-339)	ML23278A064

APPENDIX E

PROJECTS AND ACTIONS CONSIDERED IN THE CUMULATIVE IMPACTS ANALYSIS

E.1 Overview

Table E-1 identifies other past, present, and reasonably foreseeable projects and actions the U.S. Nuclear Regulatory Commission (NRC) staff considered when analyzing potential cumulative environmental impacts related to the continued operation of North Anna Power Station, Units 1 and 2 (North Anna) for an additional 20 years. The staff generally considered projects and actions within a 30-mile (mi) (48-km) radius of the North Anna site. The staff's analysis of potential cumulative impacts associated with the proposed action (subsequent license renewal [SLR] is presented in Section 3.15 of this environmental impact statement. However, because of the uniqueness of each environmental resource area evaluated and its associated geographic area of analysis, Section 3.15 does not consider or explicitly evaluate every project and action listed in Table E-1.

Table E-1 Projects and Actions NRC Staff Considered in the North Anna Subsequent License Renewal Cumulative Impacts Analysis

Facility or Project Type	Project Name	Summary of Project	Location (Relative to North Anna)	Status
Onsite Facilities/ Projects	North Anna Wastewater Treatment Plant Replacement	Installation of new permanent wastewater treatment facility	Onsite, within the existing wastewater treatment plant footprint	Project is partially funded. Plans are conceptual. Tentative construction completion in 2022 (VEPCO 2021-TN8524)
Onsite Facilities/ Projects	North Anna Osprey Nest Platform Installation	Installation of alternative nesting platforms to deter osprey nesting inside the switchyard	Onsite, several locations	One nest platform installed in February 2020. Five additional platforms installed in February 2021 (VEPCO 2021-TN8524)
Onsite Facilities/ Projects	North Anna Cyber Security Testing Facility	Construction of new facility for storing and testing critical digital assets	Onsite, west of existing steam generator storage facility	Construction scheduled for completion in 2023 (VEPCO 2021-TN8524)
Onsite Facilities/ Projects	North Anna Main Generator Storage Building	Construction of new facility for storing Unit 1 and Unit 2 main generators	Onsite, north of Warehouse 5	Construction scheduled for completion in 2023 (VEPCO 2021-TN8524)

Table E-1 Projects and Actions NRC Staff Considered in the North Anna Subsequent License Renewal Cumulative Impacts Analysis (Continued)

Facility or Project Type	Project Name	Summary of Project	Location (Relative to North Anna)	Status
Onsite Facilities/ Projects	North Anna Unit 3	Proposed 1,600 MW advanced light-water reactor unit on 120 ac (48 ha) area	Onsite, west of the existing North Anna	NRC issued combined operating license in 2017. Licensee has not made decision whether to proceed with construction (VEPCO 2020-TN8099)
Fossil Fuel Energy Facilities	Ladysmith Power Station	Natural gas-fueled power plant with 783 MW generating capacity from five units	Caroline County, approximately 15 mi (24 km) east	Operational (EIA 2021-TN8354; VEPCO 2020-TN8384; EPA 2023-TN8422)
Fossil Fuel Energy Facilities	Louisa Generation Facility	Natural gas and petroleum-fueled peaking power plant with 466 MW generating capacity from five units	Gordonsville, VA, approximately 23 mi (37 km) west-northwest	Operational (EIA 2021-TN8354; EPA 2023-TN8422; ODEC 2021-TN8551)
Fossil Fuel Energy Facilities	Gordonsville Energy	Natural gas-fueled power plant with 218 MW generating capacity from two units	Gordonsville, VA, approximately 23 mi (37 km) west-northwest	Operational (VEPCO 2020-TN8384; EIA 2021-TN8354; EPA 2023-TN8422)
Fossil Fuel Energy Facilities	Doswell Energy Center	Natural gas-fueled power plant with 1,165 MW generating capacity from five units	Ashland, VA, approximately 25 mi (40 km) southeast	Operational (EIA 2021-TN8354; EPA 2023-TN8422)
Fossil Fuel Energy Facilities	Rockville 1 and 2	Petroleum-fueled peaking units with combined 11 MW generating capacity	Rockville, VA, approximately 26 mi (41 km) south-southeast	Operational (EIA 2021-TN8354; EPA 2023-TN8422)
Fossil Fuel Energy Facilities	Birchwood Power Station	Coal-fueled power plant with 238 MW generating capacity	King George County, approximately 29 mi (47 km) northeast	Closed in March 2021 (Virginia Mercury 2021-TN8552)
Fossil Fuel Energy Facilities	Electric Avenue Plant	Petroleum-fueled peaking power plant with 6.9 MW generating capacity	Culpeper, VA, approximately 30 mi (48 km) north-northwest	Operational (EIA 2021-TN8354; EPA 2023-TN8422)
Renewable Energy Facilities	North Anna Hydro Power Station	1 MW hydroelectric facility located at the base of Lake Anna Dam	Louisa County, VA, approximately 5 mi (8 km) southeast	(VEPCO 2020-TN8099VEPCO 2020-TN8099, VEPCO 2020-TN8384)

Table E-1 Projects and Actions NRC Staff Considered in the North Anna Subsequent License Renewal Cumulative Impacts Analysis (Continued)

Facility or Project Type	Project Name	Summary of Project	Location (Relative to North Anna)	Status
Renewable Energy Facilities	Whitehouse Solar Farm	Solar photovoltaic facility with 20 MW (8 MW net) generating capacity on 250 ac (100 ha)	Louisa County, VA, approximately 10 mi (16 km) west–southwest	Operational (EIA 2021-TN8354; VEPCO 2020-TN8384)
Renewable Energy Facilities	Spotsylvania Solar Energy Center	Solar photovoltaic facility with 500 MW generating capacity on 6,350 ac (2,570 ha)	Spotsylvania County, approximately 10 mi (16 km) north	Partially online (AES 2021-TN8564; Virginia Mercury 2019-TN8553)
Renewable Energy Facilities	Belcher Solar	Solar photovoltaic facility with 88 MW generating capacity on 1,000 ac (400 ha)	Louisa County, VA, approximately 14 mi (22 km) west–southwest	Operational (VEPCO 2022-TN8550)
Renewable Energy Facilities	Madison Solar Generating Facility	Solar photovoltaic facility with 63 MW generating capacity on 660 ac (267 ha)	Orange County, VA, approximately 16 mi (26 km) north-northwest	Scheduled to be in service in 2022 (VEPCO 2020-TN8384; Solar Power World 2020-TN8554)
Renewable Energy Facilities	Martin Solar Center	Solar photovoltaic facility with 5 MW generating capacity on 35 ac (14 ha)	Goochland County, VA, approximately 19 mi (30 km) southwest	Operational (EIA 2021-TN8354; BW 2017-TN9104)
Renewable Energy Facilities	Palmer Solar Center	Solar photovoltaic facility with 5 MW generating capacity on 41 ac (16 ha)	Fluvanna County, VA, approximately 25 mi (40 km) west-southwest	Operational (EIA 2021-TN8354; BW 2017-TN9104)
Renewable Energy Facilities	Waste Management King George Landfill Gas to Energy Plant	Landfill-gas (biomass) fueled power plant (at King George County Landfill) with 11.3 MW generating capacity	King George County, approximately 29 mi (47 km) northeast	Operational (EIA 2021-TN8354; EPA 2021-TN8555)
Mining and Manufacturing Facilities	Martin-Marietta Aggregates Doswell	Quarrying/Mining Operation	Doswell, VA, approximately 19 mi (31 km) southeast	Operational (EPA 2023-TN8422; Martin Marietta 2021-TN8556)
Mining and Manufacturing Facilities	Martin-Marietta Aggregates Louisa	Quarrying/Mining Operation	Mineral, VA, approximately 5 mi (8 km) southwest	Operational (Martin Marietta 2021-TN8556)
Mining and Manufacturing Facilities	U.S. Silica	Quarrying/Mining Operation (Aplite)	Montpelier, VA, approximately 20 mi (32 km) south-southeast	Operational (EPA 2023-TN8422; US Silica 2021-TN8558)

Table E-1 Projects and Actions NRC Staff Considered in the North Anna Subsequent License Renewal Cumulative Impacts Analysis (Continued)

Facility or Project Type	Project Name	Summary of Project	Location (Relative to North Anna)	Status
Mining and Manufacturing Facilities	Klöckner Pentaplast	Plastics manufacturing facility	Gordonsville, VA, approximately 23 mi (37 km) west-northwest	Operational (EPA 2023-TN8422; Klöckner Pentaplast 2020-TN8565)
Mining and Manufacturing Facilities	Bear Island Paper Company	Pulp/Paper mill producing newsprint stock	Ashland, VA, approximately 25 mi (41 km) southeast	Plant currently being converted to produce containerboard, with restart scheduled in 2022 (EPA 2023-TN8422; Recycling Today 2020-TN8568)
Mining and Manufacturing Facilities	Martin-Marietta Aggregates Anderson Creek	Quarrying/Mining Operation	Rockville, VA, approximately 26 mi (42 km) south-southeast	Operational (EPA 2023-TN8422; Martin Marietta 2021-TN8556)
Mining and Manufacturing Facilities	Luck Stone, Rockville Plant	Quarrying/Mining Operation	Rockville, VA, approximately 26 mi (42 km) south-southeast	Operational Luck Stone 2023-TN9106)
Mining and Manufacturing Facilities	Vulcan Materials Company	Quarrying/Mining Operation	Rockville, VA, approximately 26 mi (42 km) south-southeast	Operational (EPA 2023-TN8422; Vulcan 2023-TN8569)
Military and Other Facilities	U.S. Army Garrison Fort A.P. Hill	76,000 ac (31,000 ha) Joint Forces training base under the U.S. Army Installation Management Command. Includes 27,000 ac (11,000 ha) live fire range	Caroline County, VA, approximately 25 mi (41 km) east	Operational (EPA 2023-TN8422; Army 2021-TN8570)
Landfills	Livingston Landfill and Convenience Center	Municipal (nonhazardous) solid waste landfill	Spotsylvania, VA, approximately 6 mi (10 km) northeast	Operational (EPA 2023-TN8422; Spotsylvania County 2021-TN8602)
Landfills	Louisa County Sanitary Landfill	Municipal (nonhazardous) solid waste landfill	Mineral, VA, approximately 7 mi (11 km) southwest	Operational (EPA 2023-TN8422; Louisa County 2021-TN8561)
Landfills	Orange County Sanitary Landfill	Municipal (nonhazardous) solid waste landfill	Orange, VA, approximately 18 mi (29 km) northwest	Operational (Orange County 2021-TN8563; EPA 2023-TN8422)
Landfills	Spotsylvania County Landfill	Municipal (nonhazardous) solid waste landfill	Fredericksburg, VA, approximately 20	Operational (Spotsylvania County 2023-TN8585)

Table E-1 Projects and Actions NRC Staff Considered in the North Anna Subsequent License Renewal Cumulative Impacts Analysis (Continued)

Facility or Project Type	Project Name	Summary of Project	Location (Relative to North Anna)	Status
			mi (32 km) northeast	
Water Supply and Treatment Facilities	Northeast Creek Water Treatment Plant	Municipal water supply with surface water reservoir source	Louisa, VA, approximately 10 mi (16 km) southwest	Operational (VEPCO 2020-TN8099; EPA 2023-TN8422; Louisa County 2021-TN8562)
Water Supply and Treatment Facilities	Louisa Regional Wastewater Treatment Plant	Wastewater treatment plant	Louisa, VA, approximately 12 mi (19 km) west-southwest	Operational (VEPCO 2020-TN8099; EPA 2021-TN8555; Louisa County 2021-TN8562)
Water Supply and Treatment Facilities	Caroline County Regional Wastewater Treatment Plant	Wastewater treatment plant	Ruther Glen, VA, approximately 21 mi (34 km) east-southeast	Operational (Caroline County 2023-TN8575)
Water Supply and Treatment Facilities	Doswell Water Treatment Plant	Wastewater treatment plant	Doswell, VA, approximately 24 mi (39 km) southeast	Operational (VDEQ 2020-TN8576)
Water Supply and Treatment Facilities	Zion Crossroads Water Treatment Plant	Municipal water supply with groundwater source (wellfield) and surface water reservoir	Zion Crossroads, VA, approximately 23 mi (37 km) west-southwest	Operational (EPA 2023-TN8422; Louisa County 2021-TN8562)
Water Supply and Treatment Facilities	Zion Crossroads Wastewater Treatment Facility	Wastewater treatment plant	Zion Crossroads, VA, approximately 23 mi (37 km) west-southwest	Operational (EPA 2023-TN8422; Louisa County 2021-TN8562)
Water Supply and Treatment Facilities	Massaponax Wastewater Treatment Plant	Wastewater treatment plant	Massaponax, VA, approximately 24 mi (39 km) northeast	Operational (EPA 2023-TN8422; Spotsylvania County 2021-TN8559)
Water Supply and Treatment Facilities	Motts Run Water Treatment Plant	Municipal water supply sourced from Rappahannock River and surface water reservoir	Fredericksburg, VA, approximately 22 mi (35 km) north-northeast	Operational (EPA 2023-TN8422; Spotsylvania County 2021-TN8559)
Water Supply and Treatment Facilities	Ni River Water Treatment Plant	Municipal water supply with surface water reservoir	Spotsylvania Courthouse, VA, approximately 16 mi (26 km) northeast	Operational (EPA 2023-TN8422; Spotsylvania County 2021-TN8559)

Table E-1 Projects and Actions NRC Staff Considered in the North Anna Subsequent License Renewal Cumulative Impacts Analysis (Continued)

Facility or Project Type	Project Name	Summary of Project	Location (Relative to North Anna)	Status
Water Supply and Treatment Facilities	FMC Wastewater Treatment Plant	Wastewater treatment plant	Fredericksburg, VA, approximately 24 mi (39 km) northeast	Operational (EPA 2023-TN8422; Spotsylvania County 2021-TN8559)
Water Supply and Treatment Facilities	Thornburg Wastewater Treatment Plant	Wastewater treatment plant	Thornburg, VA, approximately 16 mi (25 km) east-northeast	Operational. Facility is currently being upgraded to handle future growth (EPA 2023-TN8422; Spotsylvania County 2021-TN8559)
Parks and Recreation Sites	Lake Anna State Park	3,127-ac (1,265-ha) park with 10 mi (16 km) of lake frontage on Lake Anna offering tours, hiking, camping, picnicking, and water activities	Approximately 3 mi (5 km) north-northwest	Operational; Managed by Virginia Department of Conservation and Recreation (VEPCO 2020-TN8099; VDCR 2021-TN8417)
Parks and Recreation Sites	Fredericksburg and Spotsylvania National Military Park	Military park encompassing multiple detached units associated with four Civil War battlefields and featuring hiking and driving tours	Approximately 15 mi (24 km) northeast	Operational; Managed by National Park Service (VEPCO 2020-TN8099; NPS 2021-TN8572)
Parks and Recreation Sites	North Anna Battlefield Park	172-ac (69-ha) historic battlefield park offering hiking and picnicking	Approximately 20 mi (32 km) southeast	Operational; Managed by Virginia Department of Wildlife Resources (VEPCO 2020-TN8099; VDWR 2021-TN8577)
Parks and Recreation Sites	Green Springs National Historic Landmark District	14,000-ac (5,700-ha) district of 19th century farmsteads featuring rural architecture and landscapes	Approximately 21 mi (34 km) west	Operational; Managed by National Park Service (NPS 2021-TN8573)
Parks and Recreation Sites	Mattaponi Wildlife Management Area	2,542-ac (1,028-ha) Wildlife management area with 6.5 mi (10.4 km) of waterfront along the Mattaponi and South Rivers offering hunting, fishing, camping, and hiking	Approximately 22 mi (35 km) east	Operational; Managed by Virginia Department of Wildlife Resources (VEPCO 2020-TN8099; VDWR 2021-TN8578)

Table E-1 Projects and Actions NRC Staff Considered in the North Anna Subsequent License Renewal Cumulative Impacts Analysis (Continued)

Facility or Project Type	Project Name	Summary of Project	Location (Relative to North Anna)	Status
Parks and Recreation Sites	Kings Dominion	400-ac (160-ha) amusement park with rides and attractions	Approximately 24 mi (39 km) southeast	Operational; Privately owned and managed by Cedar Fair Entertainment Company (Kings Dominion 2021-TN8582; EPA 2021-TN8555)
Parks and Recreation Sites	C.F. Phelps Wildlife Management Area	4,539-ac (1,836-ha) wildlife management area offering hunting, fishing, canoeing, and hiking	Approximately 25 mi (40 km) north	Operational; Managed by Virginia Department of Wildlife Resources (VEPCO 2020-TN8099; VDWR 2021-TN8579)
Parks and Recreation Sites	Powhatan State Park	1,565-ac (633-ha) park on James River offering hiking, camping, picnicking, and water activities	Approximately 27 mi (43 km) south-southeast	Operational; Managed by Virginia Department of Conservation and Recreation (VEPCO 2020-TN8099; VDCR 2021-TN8583)
Parks and Recreation Sites	Oakley Forest Wildlife Management Area	4,459-ac (1,804-ha) Wildlife management area offering hunting, trapping, primitive camping, hiking, and birding	Approximately 7 mi (11 km) north-northwest	Operational; Managed by Virginia Department of Wildlife Resources (VDWR 2023-TN8580)
Parks and Recreation Sites	Elizabeth Trice Walton Park	Small municipal park	Approximately 7 mi (11 km) southwest	Operational; Owned by Mineral Fire Department (Town of Mineral 2022-TN8584)
Parks and Recreation Sites	Chewning Park	10-ac (4-ha) community park with playground and baseball fields	Approximately 9 mi (15 km) north	Operational; Managed by Spotsylvania County (Spotsylvania County 2023-TN8585)
Parks and Recreation Sites	Cutalong Master Planned Golf Community	Private golf course and planned community development	Approximately 4 mi (6 km) west-northwest	Golf course operational; residential development in progress (Cutalong at Lake Anna 2023-TN8586)
Parks and Recreation Sites	Other Recreational Areas	Six marinas on Lake Anna within 3 mi	Within 10 mi (16 km)	Operational

Table E-1 Projects and Actions NRC Staff Considered in the North Anna Subsequent License Renewal Cumulative Impacts Analysis (Continued)

Facility or Project Type	Project Name	Summary of Project	Location (Relative to North Anna)	Status
		(5 km) of the nuclear power plant site. Also, several public landings, campgrounds, and other recreational attractions		(VEPCO 2020-TN8383, VEPCO 2020-TN8099)
Transportation Facilities	Aviation Facilities	Three private airfields, two public general aviation airports, and one private-use helipad	Helipad located onsite. Others located within 10 mi (16 km) of North Anna site	Operational (AirNav 2021; VEPCO 2020-TN8099)
Other Facilities/ Project/Trends	Various minor air pollutant emissions, National Pollutant Discharge Elimination System permitted wastewater discharges, and hazardous waste small-quantity generators	Various businesses with smaller effluent discharges and waste streams	Within 10 mi (16 km)	Operational (EPA 2023-TN8422)
Other Facilities/ Project/Trends	Future Development	Construction of housing units and associated commercial buildings; roads, bridges, and rail; water and/or wastewater treatment and distribution facilities; and associated pipelines as described in local land use planning documents.	Throughout region	Construction would occur in the future, as described in State and local land use planning documents

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APPENDIX F

ENVIRONMENTAL IMPACTS OF POSTULATED ACCIDENTS

This appendix describes the environmental impacts from postulated accidents that may occur at North Anna Power Station, Units 1 and 2 (North Anna) during the subsequent license renewal (SLR) period. The term “accident” refers to any unintentional event outside the normal nuclear power plant operational envelope that could result in either (1) an unplanned release of radioactive materials into the environment or (2) the potential for an unplanned release of radioactive materials into the environment.

NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (LR GEIS) (NRC 1996-TN288, NRC 2013-TN2654), evaluates in detail the following two classes of postulated accidents as they relate to license renewal. The LR GEIS conclusions are codified in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions”:

- Design-Basis Accidents: Postulated accidents that a nuclear facility must be designed and built to withstand without loss to the systems, structures, and components necessary to ensure public health and safety.
- Severe Accidents: Postulated accidents that are more severe than design-basis accident s because they could result in substantial damage to the reactor core, with or without serious offsite consequences.

On March 21, 2022, the Commission issued CLI-22-02 (NRC 2022-TN8182) when considering the appeals of Natural Resources Defense Council, Friends of the Earth, and Miami Waterkeeper (collectively, the Intervenors), and reconsidered the Commission’s decision in CLI-20-3 (NRC 2022-TN8272, NRC 2020-TN9570). The Commission reversed CLI-20-3 (NRC 2022-TN8272), which addressed the referred ruling from the Atomic Safety and Licensing Board (ASLB). In CLI-20-3 (NRC 2022-TN8272), the Commission had held that, when considering the environmental impacts of an SLR, the U.S. Nuclear Regulatory Commission (NRC) staff may rely on the 2013 Generic Environmental Impact Statement for License Renewal of Nuclear Plants[1] (LR GEIS) and 10 CFR Part 51 (TN250) Subpart A, Appendix B, Table B-1, “Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants,” to evaluate environmental impacts of Category 1 issues. For the reasons described in CLI-22-02 (NRC 2022-TN8182), the Commission reversed that decision and held that the 2013 LR GEIS did not address SLR. The Commission stated, “that the Staff may not exclusively rely on the 2013 LR GEIS and Table B-1 for the evaluation of environmental impacts of Category 1 issues,” (NRC 2022-TN8182). As a result, in this draft EIS, the staff has conducted a site-specific evaluation of the environmental impacts of North Anna’s SLR application.

This appendix describes (1) the NRC staff’s evaluation of new and significant information related to design-basis accidents at North Anna, (2) the staff’s evaluation of new and significant information for postulated severe accidents at North Anna and (3) the staff’s evaluation of new and significant information related to the North Anna severe accident mitigation alternative

[1] “Generic Environmental Impact Statement for License Renewal of Nuclear Plants” (Final Report), NUREG-1437, Rev. 1, vols. 1–3 (June 2013), (ADAMS accession nos. ML13106A241, ML13106A242, ML13106A244) (NRC 2013-TN2654).

(SAMA) evaluation performed during initial license renewal. The NRC staff conducted this site-specific new and significant evaluation to verify that the environmental impacts of design-basis accidents and the probability-weighted consequences of postulated severe accidents for North Anna continue to be SMALL.

F.1 Background

Although this draft environmental impact statement (EIS) documents the NRC staff's review of an SLR application, it is helpful to keep in mind that long before any license renewal actions, an operating reactor has already completed the NRC licensing process for the original 40-year operating license. To receive a license to operate a nuclear power reactor, an applicant must submit to the NRC an operating license application that includes, among many other requirements, a safety analysis report. The applicant's safety analysis report presents the design criteria and design information for the proposed reactor and includes comprehensive data on the proposed site. The applicant's safety analysis report also describes various design-basis accidents and the safety features designed to prevent or mitigate their impacts. The NRC staff reviews the operating license application to determine if the nuclear power plant's design—including designs for preventing or mitigating accidents—meets the NRC's regulations and requirements. At the conclusion of that review, an operating license would be issued only if the NRC finds, in part, that there is reasonable assurance that the activities authorized by the license can be conducted without endangering the health and safety of the public and that the activities will be conducted in accordance with the NRC's regulations.

F.1.1 Design-Basis Accidents

Design-basis accidents are postulated accidents that a nuclear facility must be designed and built to withstand without loss to the systems, structures, and components necessary to ensure public health and safety. Planning for design-basis accidents ensures that the proposed nuclear power plant can withstand normal transients (e.g., rapid changes in the reactor coolant system temperature or pressure, or rapid changes in reactor power), as well as a broad spectrum of postulated accidents without undue hazard to the health and safety of the public. Many of these design-basis accidents may occur, but are unlikely to occur, even once during the life of the nuclear power plant; nevertheless, carefully evaluating each design-basis accident is crucial to establishing the design basis for the preventative and mitigative safety systems of the proposed nuclear power plant. 10 CFR Part 50 (TN249), "Domestic Licensing of Production and Utilization Facilities," and 10 CFR Part 100 (TN282), "Reactor Site Criteria," describe the NRC's acceptance criteria for design-basis accidents.

Before the NRC will issue an operating license for a new nuclear power plant, the applicant must demonstrate the ability of its proposed reactor to withstand all design-basis accidents. The applicant and the NRC staff evaluate the environmental impacts of design-basis accidents for the hypothetical individual exposed to the maximum postulated amount of radiation (maximum exposed individual member of the public). The results of these evaluations of design-basis accidents are found in the reactor's original licensing documents, such as the applicant's final safety analysis report, the NRC staff's safety evaluation report, and the final environmental statement. Once the NRC issues the operating license for the new reactor, the licensee is required to maintain the acceptable design and performance criteria (which includes withstanding design-basis accidents) throughout the operating life of the nuclear power plant, including any license-renewal periods of extended operation. The consequences of design-basis accidents are evaluated for the hypothetical maximum exposed individual; as such, changes in the nuclear power plant environment over time will not affect these evaluations.

The NRC has reviewed North Anna's design basis on several occasions following the issuance of the initial operating licenses. For example, in a 2005 Issuance of Amendments Regarding Alternative Source Term, the NRC staff determined that the radiological consequences estimated by the licensee for the North Anna Units 1 and 2, with regard to various design-basis accidents will comply with the requirements of 10 CFR 50.67, "Accident source term" and the guidelines of Regulatory Guide (RG) 1.183, "Alternative Radiological Source Terms for Evaluating Design-Basis Accidents at Nuclear Reactors," and are therefore acceptable (NRC 2000-TN517). Another example is the NRC's review of updated external hazards information for all operating power reactors (as ordered by the Commission after the Fukushima Dai-Ichi accident). On June 9, 2020, the NRC completed its review of Fukushima-related information relevant to North Anna and concluded that no further regulatory actions were needed to ensure adequate protection or compliance with regulatory requirements, thereby reconfirming the acceptability of North Anna's design basis (NRC 2020-TN8336).

The site-specific analysis of design-basis accidents is presented in the North Anna Updated Final Safety Analysis Report (UFSAR) (NRC 2016-TN9560). For plant changes during the North Anna SLR period of extended operation, the continued validity of the UFSAR is maintained in compliance with 10 CFR 50.59 (TN249), "Changes, tests and experiment." The UFSAR design-basis accident analysis forms the technical bases for the North Anna Technical Specifications for operation. The UFSAR and Technical Specifications are parts of the current licensing basis and are the subject of the NRC reactor oversight program for operation during the period of extended operation. The environmental impacts of design-basis accidents are required to meet NRC onsite and offsite regulatory dose requirements.

Pursuant to 10 CFR 54.29(a)(TN4878), license renewal applicants are required to manage the effects of aging and perform any required time-limited aging analyses (as further described in the regulation), such that there is reasonable assurance that the activities authorized by the renewed license will continue to be conducted in accordance with the plant's current licensing basis (CLB), and any changes made to the plant's CLB in order to comply with Section 54.29 are in accordance with the Atomic Energy Act of 1954, as amended (AEA; 42 U.S.C. § 2011 et seq., TN663) and the Commission's regulations. Under the NRC's rules in 10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plans," applicants for initial license renewal and SLR must take adequate steps to account for aging during the period of extended operation either by updating time-limited aging analyses or implementing appropriate aging management plans. Based on these activities, the NRC expects that operation during an initial license renewal or SLR term would continue to provide a level of safety equivalent to that provided during the initial operating license period of operations. Further, as provided in the statement of considerations for Part 54, considerable experience has demonstrated that the NRC's regulatory process, including the performance-based requirements of the maintenance rule, provide adequate assurance that degradation due to the aging of structures, systems, and components that perform active safety functions will be appropriately managed to ensure their continued functionality during the period of extended operation.

Because the requirements of the existing design basis and any necessary aging management programs will be in effect for SLR, the environmental impacts of design-basis accidents as calculated for the original operating license application should not differ significantly from the environmental impacts of design-basis accidents during other periods of plant operations, including during the initial license renewal and SLR periods.

In addition, the staff notes that in the 2013 LR GEIS, the NRC reexamined the information from the 1996 LR GEIS regarding design-basis accidents and concluded that this information is still valid. The NRC found that the environmental impacts of design-basis accidents are of SMALL significance for all nuclear plants. This conclusion was reached because the plants were designed to successfully withstand these accidents, and a licensee is required to maintain the plant within acceptable design and performance criteria, including during ~~the~~ license renewal term. It also stated that the environmental impacts during a LR term should not differ significantly from those calculated for the design-basis accident assessments conducted as part of the initial plant licensing process. Impacts from design-basis accidents would not be affected by changes in plant environment because such impacts (1) are based on calculated radioactive releases that are not expected to change, (2) are not affected by plant environment because they are evaluated for the hypothetical maximally exposed individual, and (3) have been previously determined to be acceptable (NRC 1996-TN288, NRC 2013-TN2654). For SLR of North Anna, the NRC staff finds that the same considerations apply.

In its environmental report (ER) for the North Anna SLR application, Dominion did not identify any new and significant information related to design-basis accidents at North Anna (VEPCO 2020-TN8099, VEPCO 2022-TN8270). In addition, the NRC staff did not identify any new and significant information related to design-basis accidents during its independent review of Dominion's ER and ER Supplement, through the scoping process, or in its evaluation of other available information. Therefore, the NRC staff concludes that the environmental impacts related to design-basis accidents at North Anna during the SLR period would be SMALL. In this regard, the staff notes that North Anna was designed to successfully withstand design-basis accidents. Due to the requirements for North Anna to maintain the licensing basis and implement appropriate aging management programs during the SLR term, the environmental impacts during the SLR term are not expected to differ significantly from those calculated for design-basis accidents as part of the initial plant licensing process. Based on the discussion above, the NRC staff concludes that the impacts of design-basis accidents during the SLR term for North Anna would be SMALL.

F.1.2 Design-Basis Accidents and License Renewal

Consistent with Regulatory Issue Summary RIS-2014-006, "Consideration of Current Operating Issues and Licensing Actions in License Renewal" (NRC 2014-TN7851), the early and adequate identification of design-basis accidents (prior to SLR) makes these design-basis accidents and associated structures, systems, and components a part of the CLB of the nuclear power plant as defined at 10 CFR 54.3(a) (TN4878). The NRC requires licensees to maintain the CLB of the nuclear power plant under the current operating license, as well as during any license renewal period. Therefore, under the provisions of 10 CFR 54.30 (TN4878), "Matters not subject to a renewal review," design-basis accidents are not subject to review under license renewal.

As stated in Section 5.3.2 of the 1996 LR GEIS, the NRC staff assessed the environmental impacts from design-basis accidents in individual nuclear power plant-specific EISs at the time of the initial license application review (NRC 1996-TN288). Consistent with the NRC Reactor Oversight Program/Process, a licensee is required to maintain the nuclear power plant within acceptable design and performance criteria, including during any license renewal term. As such, the NRC staff would not expect environmental impacts of continued nuclear power plant operation to change significantly, and accordingly, an additional assessment of the environmental impacts from design-basis accidents is not necessary (10 CFR Part 51-TN250, Appendix B to Subpart A, "Environmental Effect of Renewing the Operating License of a Nuclear Power Plant"). The 1996 LR GEIS concluded that the environmental impacts of design-basis accidents are of SMALL significance for all nuclear power plants, because the nuclear power plants were designed to withstand these accidents. For license renewal, the NRC designated design-basis accidents as a Category 1 generic issue—applicable to all nuclear power plants (see 10 CFR Part 51, Appendix B to Subpart A) (TN250). In accordance with the Commission's decisions in CLI-22-02 and CLI-22-03, the NRC staff has evaluated the applicable Category 1 issue conclusions from the LR GEIS on a site-specific basis for North Anna SLR, and determined that the impacts of design-basis accidents for North Anna during the SLR period of extended operations are SMALL.

F.1.3 Severe Accidents

Severe accidents are postulated accidents that are more severe than design-basis accident s because severe accidents can result in substantial damage to the reactor core, with or without serious offsite consequences. Severe accidents can entail multiple failures of equipment or functions.

F.1.4 Severe Accidents and License Renewal

Chapter 5 of the 1996 LR GEIS (NRC 1996-TN288) conservatively predicted the environmental impacts of postulated severe accidents that may occur during the period of extended operations at North Anna. Since that time, the NRC staff's prediction has been confirmed by a plant specific SAMA evaluation at North Anna which is found in the North Anna initial license renewal application (VEPCO 2001-TN8297).

In the 1996 LR GEIS, the NRC considered impacts of severe accidents including:

- dose and health effects of accidents
- economic impacts of accidents
- effect of uncertainties on the results

The NRC staff calculated these estimated impacts by studying the risk analysis of severe accidents as reported in the EISs and/or final environmental statements that the NRC staff had prepared in support of each nuclear power plant's original reactor operating license review. When the NRC staff prepared the 1996 LR GEIS, 28 nuclear power plant sites (44 units) had EISs or final environmental statements that contained a severe accident analysis. Not all original operating reactor licenses contained a severe accident analysis because the NRC had not always required such analyses. The 1996 LR GEIS assessed the environmental impacts of severe accidents during the license renewal period for all nuclear power plants by using the results of existing analyses and site-specific information to make conservative predictions. With few exceptions, the severe accident analyses evaluated in the 1996 LR GEIS were limited to consideration of reactor accidents caused by internal events. The 1996 LR GEIS addressed the impacts from external events (e.g., earthquakes and flooding) qualitatively.

For its severe accident environmental impact analysis for each nuclear power plant, the 1996 LR GEIS used very conservative 95th percentile upper-confidence bound estimates for environmental impact whenever available. This approach provides conservatism to cover uncertainties, as described in Section 5.3.3.2.2 of the 1996 LR GEIS. The 1996 LR GEIS concluded that the probability-weighted consequences of severe accidents as related to license renewal are SMALL compared to other risks to which the populations surrounding nuclear power plants are routinely exposed. Since issuing the 1996 LR GEIS, the NRC's understanding of severe accident risk has continued to evolve.

The updated 2013 LR GEIS assesses more recent information and developments in severe accident analyses and how they might affect the conclusions in Chapter 5 of the 1996 LR GEIS. The 2013 LR GEIS also provides comparative data where appropriate. Based on information in the 2013 LR GEIS, the NRC staff determined that for all nuclear power plants, the probability-weighted consequences of severe accidents are SMALL. However, the LR GEIS determined that alternatives to mitigate severe accidents must be considered for all nuclear power plants that have not considered such alternatives, as a Category 2 issue. See Table B-1, "Summary of Findings on NEPA [National Environmental Policy Act] Issues for License Renewal of Nuclear Power Plants," of Appendix B to Subpart A of 10 CFR Part 51-TN250, which states:

> The probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts from severe accidents are SMALL for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives.

The NRC's regulations in 10 CFR Part 51-TN250, which implement Section 102(2) of NEPA, require that all applicants for license renewal must submit an ER to the NRC, in which they identify any ''new and significant information regarding the environmental impacts of license renewal of which the applicant is aware'' (10 CFR 51.53(c)(3)(iv). This includes new and significant information that could affect the environmental impacts related to postulated severe accidents or that could affect the results of a previous SAMA analysis. Therefore, the licensee performed an analysis of SAMAs for North Anna at the time of initial license renewal (VEPCO 2001-TN8297). The staff documented its SAMA review in NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 7, Regarding North Anna, Units 1 and 2* (NRC 2002-TN8296). For the SLR application ER, Dominion evaluated areas of new and significant information that could affect the environmental impact of postulated severe accidents during the SLR period of extended operation and possible new and significant information as it relates to SAMAs.

For the North Anna SLR SAMA analysis, the NRC staff considered any new and significant information applicable to SLR that might alter the conclusions presented in the LR GEIS or the staff's SAMA evaluation conducted for initial license renewal of North Anna Units 1 and 2, as discussed below.

F.2 Severe Accident Mitigation Alternatives (SAMAs)

In a SAMA analysis, the NRC requires license renewal applicants to consider the environmental impacts of severe accidents, their probability of occurrence, and potential means to mitigate those accidents. As quoted above, 10 CFR Part 51-TN250, Table B-1 states, "Alternatives to mitigate severe accidents must be considered for all nuclear power plants that have not considered such alternatives." This NRC requirement to consider alternatives to mitigate severe accidents can be fulfilled by a SAMA analysis. The purpose of the SAMA analysis is to identify design alternatives, procedural modifications, or training activities that may further reduce the risks of severe accidents at nuclear power plants and that are also potentially cost-beneficial to implement. The SAMA analysis includes the identification and evaluation of SAMAs that may reduce the radiological risk from a severe accident by preventing substantial core damage (i.e., preventing a severe accident) or by limiting releases from containment if substantial core damage occurs (i.e., mitigating the impacts of a severe accident) (NRC 2013-TN2654). The regulation at 10 CFR 51.53(c)(3)(ii)(L) (TN250), states that each license renewal applicant must submit an environmental report that considers alternatives to mitigate severe accidents "[i]f the staff has not previously considered severe accident mitigation alternatives for the applicant's nuclear power plant in an environmental impact statement or related supplement or in an environmental assessment."

F.2.1 North Anna Initial License Renewal Application and SAMA Analysis in 2001

As part of its initial license renewal application submitted in 2001, Dominion's environmental report included an analysis of SAMAs for North Anna (VEPCO 2001-TN8297). Dominion based this SAMA analysis on: (1) the North Anna probabilistic risk assessment (PRA) for total accident frequency, core damage frequency (CDF), and containment large early release frequency (LERF); and (2) a supplemental analysis of offsite consequences and economic impacts for risk determination. The North Anna PRA included a Level 1 analysis to determine the CDF from internally initiated events and a Level 2 analysis to determine containment performance during severe accidents. The offsite consequences and economic impacts analyses (Level 3 PRA) used the MELCOR Accident Consequence Code System 2 code, Version 1.12, to determine the offsite risk impacts on the surrounding environment and the public. Inputs for the latter analysis included nuclear power plant- and site-specific values for core radionuclide inventory, source term and release fractions, meteorological data, projected population distribution (based on 1990 census data, projected out to 2030),[2] emergency response evacuation modeling, and economic data. To help identify and evaluate potential SAMAs, Dominion considered insights and recommendations from SAMA analyses for other nuclear power plants, potential nuclear power plant improvements discussed in NRC and industry documents, and documented insights that the North Anna staff provided.

In its 2001 environmental report, Dominion considered 158 SAMA candidates. Dominion then performed a qualitative screening of those SAMAs, eliminating SAMAs that were not applicable to North Anna or had already been implemented at North Anna. Based on this qualitative screening, 107 SAMAs were eliminated, leaving 51 SAMAs subject to the final screening and evaluation process. The 51 remaining SAMAs are listed in Table G.2-2 of Appendix G of the 2001 ER (VEPCO 2001-TN8297). The final screening process involved identifying and eliminating those SAMAs whose cost exceeded twice their benefit. Ultimately, Dominion concluded that there were no potentially cost-beneficial SAMAs associated with the initial North Anna license renewal (VEPCO 2001-TN8297).

As part of its review of the initial North Anna license renewal application, the NRC staff reviewed Dominion's 2001 analysis of SAMAs for North Anna, as documented in Supplement 7 to NUREG-1437 (NRC 2002-TN8296). Chapter 5 of Supplement 7 to NUREG-1437 contains the NRC staff's evaluation of the potential environmental impacts of nuclear power plant accidents and examines each SAMA (individually and, in some cases, in combination) to determine the SAMA's individual risk reduction potential. The NRC staff then compared this potential risk reduction against the cost of implementing the SAMA to quantify the SAMA's cost-benefit value.

In Section 5.2 of NUREG-1437, Supplement 7, the NRC staff found that Dominion used a systematic and comprehensive process for identifying potential nuclear power plant improvements for North Anna, and that its bases for calculating the risk reductions afforded by these nuclear power plant improvements were reasonable and generally conservative (NRC 2002-TN8296). Further, the NRC staff found that Dominion's estimates of the costs of implementing each SAMA were reasonable and consistent with estimates developed for other operating reactors. In addition, the NRC staff concluded that Dominion's cost-benefit

[2] In contrast, as discussed in Section F.3.9 below, Dominion's ER for SLR utilized projected population values for the year 2060 (VEPCO 2020-TN8099).

comparisons were performed appropriately. The NRC staff concluded that Dominion's SAMA methods and implementation of those methods were sound. The NRC staff agreed with Dominion's conclusion that none of the candidate SAMAs were potentially cost-beneficial based on conservative treatment of costs and benefits. The staff found that Dominion's conclusion was: (a) consistent with the low residual level of risk indicated in the North Anna PRA and (b) consistent with the fact that North Anna had already implemented many nuclear power nuclear power plant improvements identified during two risk analysis processes. These two risk analysis process were (1) the individual plant examination (IPE), a risk analysis that considers the unique aspects of a particular nuclear power plant, identifying the specific vulnerabilities to severe accidents of that nuclear power plant and, (2) the individual plant examination of external events (IPEEE), a risk analysis that considers external events such as earthquakes and high winds.

F.2.2 Subsequent License Renewal Application and New and Significant Information as It Relates to SAMA

As mentioned above, a license renewal application must include an ER that describes SAMAs if the NRC staff has not previously evaluated SAMAs for that nuclear power plant in an EIS, in a related supplement to an EIS, or in an environmental assessment. As also discussed above, the NRC staff performed a site-specific analysis of North Anna SAMAs in NUREG-1437, Supplement 7 (NRC 2002-TN8296). Therefore, in accordance with 10 CFR 51.53(c)(3)(ii)(L) and Table B-1 of Appendix B to Subpart A of 10 CFR Part 51-TN250, Dominion is not required to provide another SAMA analysis in its ER for the North Anna SLR application.

In Dominion's assessment of new and significant information related to SAMAs in its SLR application, Dominion used the Nuclear Energy Institute (NEI) guidance document, NEI 17-04, Revision 1, "Model SLR [Subsequent License Renewal] New and Significant Assessment Approach for SAMA" (NEI 2019-TN6815), which the NRC staff has endorsed (NRC 2019-TN7805). As discussed in Section F.5 below, NEI developed a model approach for license renewal applicants to use in assessing the significance of new information, of which the applicant is aware, that relates to a prior SAMA analysis that was performed in support of the issuance of an initial license, renewed license, or combined license.

NEI 17-04 provides a tiered approach that entails a three-stage screening process for the evaluation of new information. In this screening process, new information is deemed to be "potentially significant" to the extent that it results in the identification in Stage 1 (involving the use of PRA risk insights and/or risk model quantifications) of an unimplemented SAMA that reduces the maximum benefit by 50 percent or more. Maximum benefit is defined in Section 4.5 of NEI 05-01, Revision A, "Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document" (NEI 2005-TN1978), as the benefit a SAMA could achieve if it eliminated all risk. The total offsite dose and total economic impact are the baseline risk measures from which the maximum benefit is calculated.

If a SAMA is found to result in a 50-percent reduction in maximum benefit in Stage 1, a Stage 2 assessment would then be performed (involving an updated averted cost-risk estimate for implementing that SAMA). A Stage 3 assessment (involving a cost-benefit analysis) would be required only for "potentially significant" SAMAs (i.e., those that are shown by the Stage 2 assessment to reduce the maximum benefit by 50 percent or more). Finally, if the Stage 3 assessment shows that a "potentially significant" SAMA is "potentially cost-beneficial," thus indicating the existence of "new and significant" information, then the applicant must supplement the previous SAMA analysis. The NRC staff endorsed NEI 17-04, Revision 1, for use by license renewal applicants on December 11, 2019 (NRC 2019-TN7805). Dominion's assessment of new and significant information related to its SAMA cost-benefit analysis is discussed in Section F.5 of this appendix.

Below, the NRC staff summarizes possible areas of new and significant information and assesses Dominion's conclusions.

F.3 Evaluation of New Information Concerning Severe Accident Probability Weighted Consequences for North Anna

The 2013 LR GEIS considers developments in nuclear power plant operation and accident analysis that could have changed the assumptions made in the 1996 LR GEIS concerning severe accident consequences. The 2013 LR GEIS confirmed the determination in the 1996 LR GEIS that the probability-weighted consequences of severe accidents are SMALL for all nuclear power plants. In the 2013 LR GEIS, Appendix E provides the NRC staff's evaluation of the environmental impacts of postulated accidents. Table E-19, "Summary of Conclusions," of the 2013 LR GEIS shows the developments that the NRC staff considered, as well as the staff's conclusions. Consideration of the items listed in Table E-19 was the basis for the NRC staff's overall determination in the 2013 LR GEIS that the probability-weighted consequences of severe accidents remain SMALL for all nuclear power plants.

For SLR for North Anna, the staff confirmed that there is no new and significant information that would change the 1996 LR GEIS conclusions regarding the probability-weighted consequences of severe accidents Similarly, the NRC staff evaluated Dominion's plant specific information to determine if there was any new and significant information that would warrant changes to the staff's conclusions in the 2002 Supplemental Environmental Impact Statement (SEIS) for initial license renewal of North Anna's operating licenses. The staff did not identify any new and significant information during the North Anna audit (NRC 2020-TN8100), during the scoping process, and through the evaluation of other site-specific information that would warrant a different conclusion for the probability weighted consequences of severe accidents during the North Anna SLR term. The results of the staff's review follow.

F.3.1 New Internal Events Information (Section E.3.1 of the 2013 LR GEIS)

After Dominion submitted the North Anna initial license renewal application ER in 2001 and the NRC staff issued its corresponding SAMA review in its 2002 SEIS, there have been many improvements to North Anna's risk profile (NRC 2002-TN8296). The North Anna internal events CDF in the initial license renewal SAMA was approximately 3.50×10^{-5}/year (VEPCO 2001-TN8297). The current North Anna internal events PRA model of record has a CDF of approximately 1.36×10^{-6}/year (VEPCO 2020-TN8099). This change represents a 96-percent reduction or a factor of 25 reduction in CDF for each unit. Therefore, no new and significant information exists for North Anna concerning offsite consequences of severe accidents initiated by internal events during the SLR term.

Using North Anna internal events information, the 1996 LR GEIS indicated that the non-normalized predicted total population dose risk (person-rem/RY) (95 percent upper confidence bound) for North Anna Units 1 and 2 was 1,496 person-rem RY. The population dose risk is equivalent to the probability weighted consequences of a severe accident to the public and environment. The North Anna Units 1 and 2 initial license renewal SAMA total population dose risk was calculated to be 50 person-rem/RY. This provides a ratio of the North Anna 1996 LR

GEIS 95 percent upper confidence bound predicted population dose, to North Anna initial license renewal total population dose risk (i.e., 1,496/50), of 30.

Therefore, considering the CDF reduction in North Anna's risk profile, the NRC staff concludes that the offsite consequences of severe accidents initiated by internal events during the SLR term at North Anna would not change the conclusions of the 1996 LR GEIS. For these issues, the 1996 LR GEIS predicted that the probability-weighted consequences of severe accidents would be SMALL for all nuclear power plants. The NRC staff identified no new and significant information regarding internal events during its review of Dominion's ER and ER supplement, during the SAMA audit, through the scoping process, or through the evaluation of other available information. Thus, the NRC staff concludes that no new and significant information exists for North Anna during the SLR term concerning the offsite consequences of severe accidents initiated by internal events that would alter the conclusion that the probability-weighted consequences of severe accidents would be SMALL reached in the 1996 LR GEIS, the 2013 LR GEIS, and the North Anna initial LR SEIS.

F.3.2 External Events (Section E.3.2 of the 2013 LR GEIS)

The 1996 LR GEIS concluded that severe accidents initiated by external events (such as earthquakes) could have potentially high consequences, but also found that the risks from these external events are adequately addressed through a consideration of severe accidents initiated by internal events (such as a loss of cooling water). As summarized in the 2013 LR GEIS, the mean pressurized-water reactor (PWR) internal event CDF in the original EISs that were used in the 1996 LR GEIS to estimate probability-weighted, offsite consequences from airborne, surface water, and groundwater pathways, as well as the resulting economic impacts from such pathways, was 8.4×10^{-5} per reactor-year (NRC 2013-TN2654).

The 2013 LR GEIS expanded the scope of the evaluation in the 1996 LR GEIS and used more recent technical information that included both internally and externally initiated event core-damage frequencies. Section E.3.2.3 of the 2013 LR GEIS concludes that the CDFs from severe accidents initiated by external events, as quantified in NUREG-1150, *Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants* (NRC 1990-TN525), and other sources documented in the LR GEIS, are comparable to CDFs from accidents initiated by internal events, but lower than the CDFs that formed the basis for the 1996 LR GEIS. This is evident, for example, in the CDFs from severe accidents at North Anna. The fire and seismic CDFs (3.9×10^{-6} per reactor-year [NRC 2002-TN8296] and 6×10^{-5} per reactor-year [VEPCO 2020-TN8099], respectively) for North Anna, as well as the sum of the two, were less than the mean PWR internal event CDF (8.4×10^{-5} per reactor-year) (NRC 2013-TN2654) that had been considered in the original EISs used in the 1996 LR GEIS to estimate probability-weighted weighted, offsite consequences from airborne, surface water, and groundwater pathways, as well as the resulting economic impacts from such pathways.

Dominion indicated that the "North Anna-R07i" model was used to determine the level of significance of new information. This model includes internal events (including internal floods) and a Seismic PRA, which takes into account the 2011 Mineral, Virginia, earthquake (VEPCO 2020-TN8099). Dominion indicated this PRA model reflected the most up-to-date understanding of nuclear power plant risk at the time of analysis. The staff determined that this approach is sufficient to evaluate new and significant information related to SAMAs because use of the model was consistent with the NEI 17-04 methodology.

On March 12, 2012, the NRC issued a request under 10 CFR 50.54(f) (TN249), as part of implementing lessons learned from the accident at Fukushima, that, among other things, requested licensees to reevaluate the seismic hazards at their sites using present-day methodologies and guidance to develop a ground motion response spectrum (TN7762). Since the reevaluated seismic hazard for North Anna, as characterized by the ground motion response spectrum, was not bounded by the current nuclear power plant design-basis SSE (safe-shutdown earthquake), the NRC requested that Dominion complete a Seismic PRA to determine if nuclear power plant enhancements were warranted. Dominion submitted its Seismic PRA on March 28, 2018 (VEPCO 2018-TN8330). The NRC staff reviewed Dominion's Seismic PRA and concluded that the results and risk insights provided by the Seismic PRA support the NRC's determination that no further response or regulatory action is required at North Anna (NRC 2019-TN8333). The staff indicated that a backfit was not warranted because the staff did not identify any potential modifications that (1) would result in substantial reductions in the seismic core damage frequency and mean-seismic large-early release frequency, (2) would be a substantial safety improvement, or (3) would be necessary for adequate protection or compliance. The staff also noted that the actions taken by Dominion and experience gained after the 2011 Mineral earthquake "provide additional assurance regarding North Anna's ability to handle a beyond-design-basis seismic event" (NRC 2019-TN8333). In its June 9, 2020, letter completing its post-Fukushima assessment for North Anna, the staff noted that North Anna had implemented the safety enhancements mandated by the NRC based on the lessons learned from the Fukushima accident, and stated that the NRC will continue to provide oversight of North Anna's seismic safety enhancements through the Reactor Oversight Process (NRC 2020-TN8100, NRC 2020-TN8336).

The 1996 LR GEIS indicated that the non-normalized predicted total population dose risk (person-rem/RY) (95 percent upper confidence bound) for North Anna Units 1 and 2 was 1,496 person-rem RY. The population dose risk is equivalent to the probability weighted consequences of a severe accident to the public and environment. The North Anna Units 1 and 2 initial license renewal SAMA total population dose risk was calculated to be 50 person-rem/RY. This provides a ratio of the North Anna 1996 LR GEIS 95 percent upper confidence bound predicted population dose to North Anna initial license renewal total population dose risk of 30. This considerable margin offsets any increases in external events since the previous SAMA analysis.

In conclusion, there was greater than a factor of 25 decrease in the North Anna internal events CDF. North Anna also performed a Seismic PRA (external events) to determine if nuclear power plant enhancements were warranted; and the staff determined that North Anna had implemented the safety enhancements mandated by the NRC based on the lessons learned from the Fukushima accident. Additionally, the 2013 LR GEIS evaluated the sum of the North Anna external events CDFs which was lower than the CDFs that formed the basis for the 1996 LR GEIS. Therefore, the NRC staff concludes that the probability-weighted offsite consequences of severe accidents initiated by external events during the SLR term would not exceed the estimated consequences reported in both the 1996 LR GEIS and 2013 LR GEIS. The 1996 LR GEIS predicted that the probability weighted offsite consequences of severe accidents would be SMALL for all nuclear power plants. The SEIS for North Anna's initial license renewal reached the same conclusion for the initial LR period of extended operation. The NRC staff has identified no new and significant information regarding external events during the SLR term at North Anna, in its review of Dominion's ER and ER supplement, through the SAMA audit, during the scoping process, or through the evaluation of other available information that would alter this conclusion for North Anna SLR. Thus, the NRC staff concludes that no new and significant information exists for North Anna concerning the offsite consequences of severe accidents initiated by external events that would alter the conclusion that the probability-weighted consequences of severe accidents would be SMALL for North Anna during the SLR term.

F.3.3 New Source Term Information (Section E.3.3 of the 2013 LR GEIS)

The source term refers to the magnitude and mix of the radionuclides released from the fuel (expressed as fractions of the fission product inventory in the fuel), as well as their physical and chemical form, and the timing of their release following an accident. The 2013 LR GEIS concludes that, in most cases, more recent estimates give significantly lower release frequencies and release fractions than was assumed in the 1996 LR GEIS. Thus, the environmental impacts of radioactive materials released during severe accidents, used as the basis for the 1996 LR GEIS (i.e., the frequency-weighted release consequences), are higher than the environmental impacts that would be estimated today using more recent source term information. The NRC staff also notes that results from the NRC's State-of-the-Art Reactor Consequence Analysis (SOARCA) project (which represents a significant ongoing effort to re-quantify realistic severe accident source terms) confirm that source term timing and magnitude values calculated in the SOARCA reports are significantly lower than those quantified in previous studies. The NRC staff expects to incorporate the information gleaned from the SOARCA project in future revisions of the LR GEIS (NRC 2013-TN2654).

The 1996 LR GEIS indicated that the non-normalized predicted total population dose risk (person-rem/RY) (95 percent upper confidence bound) for North Anna Units 1 and 2 was 1,496 person-rem RY. The population dose risk is equivalent to the probability weighted consequences of a severe accident to the public and environment. The North Anna Units 1 and 2 initial license renewal SAMA total population dose risk was calculated to be 50 person-rem/RY. This provides a ratio of the North Anna 1996 LR GEIS 95 percent upper confidence bound predicted population dose, to the North Anna initial license renewal total population dose risk, (i.e., 1,496/50) of 30. This considerable margin accounts for any increases in external events since the previous SAMA analysis.

For the reasons described above, current source term (timing and magnitude) at North Anna is likely to have significantly smaller effects than had been quantified in previous studies and the initial license renewal North Anna SAMA analysis in 2001. Therefore, the offsite consequences of severe accidents initiated by the new source term during the SLR term would not exceed the impacts predicted in the North Anna initial LR SEIS or the 2013 LR GEIS. For these issues, the LR GEIS predicts that the probability-weighted consequences of severe accidents would be SMALL for all nuclear power plants. The NRC staff identified no new and significant information regarding the source term for North Anna SLR during its review of Dominion's ER and ER supplement, through the SAMA audit, during the scoping process, or through the evaluation of other available information that would alter that conclusion for North Anna during the SLR period of extended operation. Thus, the NRC staff concludes that no new and significant information exists for North Anna during the SLR term concerning the offsite consequences of severe accidents initiated by new source term information that would alter the conclusion that the probability-weighted consequences of severe accidents would be SMALL for North Anna during the SLR period of extended operations.

F.3.4 Power Uprate Information (Section E.3.4 of the 2013 GEIS)

Operating at a higher reactor power level results in a larger fission product radionuclide inventory in the core than if the reactor were operating at a lower power level. In the event of an accident, the larger radionuclide inventory in the core would result in a larger source term. If the accident is severe, the release of radioactive materials from this larger source term could result in higher doses to offsite populations.

LERF represents the frequency of event sequences that could result in early fatalities. The impact of a power uprate on early fatalities can be measured by considering the impact of the uprate on the LERF calculated value. To this end, Table E-14 of the 2013 LR GEIS presents the change in LERF calculated by each licensee that has been granted a power uprate of greater than 10 percent. Table E-14 shows that the increase in LERF ranges from a minimal impact to an increase of about 30 percent (with a mean of 10.5 percent). The 2013 LR GEIS, Section E.3.4.3, “Conclusion,” determines that a power uprate will result in a small (in some cases) to moderate increase in the environmental impacts from a postulated accident. However, taken in combination with the other information presented in the LR GEIS, the increases would be bounded by the 95-percent upper-confidence bound values in Table 5.10 and Table 5.11 of the 1996 LR GEIS.

In 2009, the NRC approved a 1.6-percent measurement uncertainty recapture (MUR) at North Anna, from 2,893 megawatts thermal (MWt) to 2,940 MWt (NRC 2009-TN8337). The MUR uprate is included in the current North Anna CDF and LERF. In the staff’s safety evaluation for the MUR uprate, the change in nuclear power plant risk due to the uprate was determined to be insignificant since the power level increase is only 1.6-percent. The NRC staff’s safety evaluation for the MUR power uprate concluded that the CLB (10 CFR 54.3-TN4878, “Definitions”) dose-consequence analyses for design-basis accidents will remain bounding at the proposed MUR uprated power level (NRC 2009-TN8337).

Therefore, the NRC staff finds that the offsite consequences from the power uprate would not exceed the consequences predicted in the 2013 LR GEIS. The NRC staff has identified no new and significant information regarding power uprates during its review of Dominion’s ER and ER supplement, through the SAMA audit, during the scoping process, or through the evaluation of other available information that would alter this conclusion. Thus, the NRC staff concludes that no new and significant information exists for North Anna concerning the offsite consequences of severe accidents influenced by power uprates during the SLR term that would alter the conclusion that the probability-weighted consequences of severe accidents would be SMALL for North Anna during the SLR period of extended operations.

F.3.5 Higher Fuel Burnup Information (Section E.3.5 of the 2013 LR GEIS)

According to the 2013 LR GEIS, increased peak fuel burnup from 42 to 75 gigawatt days per metric ton uranium (GWd/MTU) for PWRs, and 60 to 75 GWd/MTU for boiling-water reactors, results in small to moderate increases (up to 38 percent) in population dose in the event of a severe accident. However, taken in combination with the other information presented in the 2013 LR GEIS, the increases would be bounded by the 95-percent upper-confidence bound values in Table 5.10 and Table 5.11 of the 1996 LR GEIS.

In Section 4.13.4.4 of the ER, Dominion indicated that the average burnup level of the peak rod is not planned to exceed 60,000 MWd/MTU during the proposed SLR operating term. Therefore, the offsite consequences from higher fuel burnup would not exceed the consequences predicted in the 2013 LR GEIS. For these issues, the LR GEIS predicted that the probability-weighted consequences would be small for all nuclear power plants. The NRC staff identified no new and significant information regarding higher fuel burnup during its review of Dominion’s ER and ER supplement, through the SAMA audit, during the scoping process, or through the evaluation of other available information. Thus, the staff concludes that no new and significant information exists for North Anna SLR concerning offsite consequences due to higher fuel burnup that would alter the conclusions reached in the 1996 LR GEIS and 2013 LR GEIS or the North Anna initial LR SEIS. Thus, the NRC staff concludes that no new and significant information exists for North Anna during the SLR term concerning the offsite consequences of severe accidents influenced by higher fuel burnup information that would alter the conclusion that the probability-weighted consequences of severe accidents would be SMALL for North Anna during the SLR period of extended operations.

F.3.6 Low Power and Reactor Shutdown Event Information (Section E.3.6 of the 2013 LR GEIS)

The 1996 LR GEIS estimates of the environmental impact of severe accidents bound potential impacts from accidents at low power and shut down, with margin. The NRC evaluated the Surry nuclear power plant in NUREG-1150 and NUREG/CR-6144; North Anna is a similarly designed nuclear power plant (i.e., both Surry and North Anna are Westinghouse PWRs with large containments), and there are no nuclear power plant configurations in low power and shutdown conditions that are likely to distinguish North Anna from the evaluated Surry nuclear power plants such that the assumptions in the 1996 LR GEIS and 2013 LR GEIS would not apply. Additionally, the 2013 LR GEIS concludes that the environmental impacts from accidents at low power and shutdown conditions are generally comparable to those from accidents at full power, based on a comparison of the values in NUREG/CR-6143, *Evaluation of Potential Severe Accidents During Low Power and Shutdown Operations at Grand Gulf, Unit 1* (SNL 1995-TN7783), and NUREG/CR-6144, *Evaluation of Potential Severe Accidents During Low Power and Shutdown Operations at Surry, Unit 1* (BNL 1995-TN7776), with the values in NUREG-1150, *Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants* (NRC 1990-TN525).

Finally, as discussed in SECY-97-168, "Issuance for Public Comment of Proposed Rulemaking Package for Shutdown and Fuel Storage Pool Operation," (NRC 1997-TN7621) industry initiatives taken during the early 1990s have also contributed to the improved safety of low power and shutdown operations for all nuclear power plants. Therefore, the offsite consequences of severe accidents, considering low power and reactor shutdown events, during the North Anna SLR term would not exceed the impacts predicted in either the 1996 LR GEIS or 2013 LR GEIS. For these issues, the LR GEIS predicts that the probability-weighted consequences of severe accidents would be small for all nuclear power plants. Further, the NRC staff identified no new and significant information for North Anna SLR regarding low power and reactor shutdown events during its review of Dominion's ER and ER Supplement, through the NRC staff's SAMA audit, during the scoping process, or through the evaluation of other available information. Thus, the staff concludes that no new and significant information exists for North Anna during the SLR term, concerning low power and reactor shutdown events that would alter the conclusion that the probability-weighted consequences of severe accidents would be SMALL for North Anna during the SLR term.

F.3.7 Spent Fuel Pool Accident Information (Section E.3.7 of the 2013 LR GEIS)

The 2013 LR GEIS concludes that the environmental impacts from accidents involving spent fuel pools (as quantified in NUREG-1738, *Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants* [NRC 2001-TN5235]), can be comparable to those from reactor accidents at full power (as estimated in NUREG-1150 [NRC 1990-TN525]). The 2013 LR GEIS further indicates that subsequent analyses performed, and mitigative measures employed since 2001, have further lowered the risk of accidents involving spent fuel pools. In addition, the LR GEIS notes that even the conservative estimates from NUREG-1738 are much lower than the impacts from full-power reactor accidents estimated in the 1996 LR GEIS. Therefore, the LR GEIS concludes, the environmental impacts stated in the 1996 LR GEIS bound the impact from spent fuel pool accidents for all nuclear power plants. For these issues, the LR GEIS predicts that the impacts would be SMALL for all nuclear power plants. There are no spent fuel configurations that would distinguish North Anna from the evaluated nuclear power plants such that the assumptions in the 1996 LR GEIS and 2013 LR GEIS would not apply. Further, the NRC staff identified no new and significant information regarding spent fuel pool accidents for North Anna during SLR term during its review of Dominion's ER and ER Supplement, through the SAMA audit, during the scoping process, or through the evaluation of other available information. Thus, the NRC staff concludes that no new and significant information exists for North Anna during the SLR term concerning spent fuel pool accidents that would alter the conclusion that the probability-weighted consequences of severe accidents would be SMALL for North Anna during the SLR term.

F.3.8 Use of Biological Effects of Ionizing Radiation VII Risk Coefficients (Section E.3.8 of the 2013 LR GEIS)

In 2005, the NRC staff completed a review of the National Academy of Sciences report, "Health Risks from Exposure to Low Levels of Ionizing Radiation: Biological Effects of Ionizing Radiation (BEIR) VII, Phase 2." The staff documented its findings in SECY-05-0202, "Staff Review of the National Academies Study of the Health Risks from Exposure to Low Levels of Ionizing Radiation (BEIR VII)" (NRC 2005-TN4513). The SECY paper states that the NRC staff agrees with the BEIR VII report's major conclusion—namely, the current scientific evidence is consistent with the hypothesis that there is a linear, no-threshold, dose-response relationship between exposure to ionizing radiation and the development of cancer in humans. The BEIR VII conclusion is consistent with the hypothesis on radiation exposure and human cancer that the NRC uses to develop its standards of radiological protection. Therefore, the NRC staff has determined that the conclusions of the BEIR VII report do not warrant any change in the NRC's radiation protection standards and regulations because the NRC's standards are adequately protective of public health and safety and will continue to apply during the North Anna SLR term. This general topic is discussed further in the NRC's 2007 denial of Petition for Rulemaking (PRM)-51-11 (72 FR 71083 2007-TN7789), in which the NRC stated that it finds no need to modify the 1996 LR GEIS considering the BEIR VII report. For these issues, the LR GEIS predicts that the impacts of using the BEIR VII risk coefficients would be SMALL for all nuclear power plants.

The NRC staff identified no new and significant information regarding the risk coefficient used in the BEIR VII report during its review of Dominion's ER and ER supplement, through the SAMA audit, during the scoping process, or through the evaluation of other available information. Thus, the staff concludes that no new and significant information exists for North Anna during the SLR term concerning the biological effects of ionizing radiation that would alter the conclusion that the probability-weighted consequences of severe accidents would be SMALL for North Anna during the SLR term.

F.3.9 Uncertainties (Section E.3.9 of the 2013 LR GEIS)

Section 5.3.3 in the 1996 LR GEIS provides a discussion of the uncertainties associated with the analysis in the LR GEIS and in the individual nuclear power plant EISs used to estimate the environmental impacts of severe accidents. The 1996 LR GEIS used 95th percentile upper-confidence bound estimates whenever available for its estimates of the environmental impacts of severe accidents. This approach provides conservatism to cover uncertainties, as described in Section 5.3.3.2.2 of the 1996 LR GEIS. Many of these same uncertainties also apply to the analysis used in the 2013 LR GEIS update. As discussed in Sections E.3.1 through E.3.8 of the 2013 LR GEIS, the LR GEIS update used more recent information to supplement the estimate of environmental impacts contained in the 1996 LR GEIS. In effect, the assessments contained in Sections E.3.1 through E.3.8 of the 2013 LR GEIS provided additional information and insights into certain areas of uncertainty associated with the 1996 LR GEIS. However, as provided in the 2013 LR GEIS, the impact and magnitude of uncertainties, as estimated in the 1996 LR GEIS, bound the uncertainties introduced by the new information and considerations addressed in the 2013 LR GEIS. Accordingly, in the 2013 LR GEIS, the NRC staff concluded that the reduction in environmental impacts resulting from the use of new information (since the 1996 LR GEIS analysis) outweighs any increases in impact resulting from the new information. As a result, the findings in the 1996 LR GEIS remain valid. The NRC staff identified no new and significant information regarding uncertainties during its review of Dominion’s ER and ER supplement, the SAMA audit, the scoping process, or the evaluation of other available information. Accordingly, the NRC staff concludes that no new and significant information exists for North Anna during the SLR term concerning uncertainties that would alter the conclusions reached in the 1996 LR GEIS and 2013 LR GEIS or the North Anna initial LR SEIS.

Section E.3.9.2 of Appendix E to the 2013 LR GEIS discusses the impact of population increases on offsite dose and economic consequences. The 2013 LR GEIS, in Section E.3.9.2, states the following:

> The 1996 GEIS estimated impacts at the mid-year of each plant’s license renewal period (i.e., 2030 to 2050). To adjust the impacts estimated in the NUREGs and NUREG/CRs to the mid-year of the assessed plant’s license renewal period, the information (i.e., exposure indexes [EIs]) in the 1996 GEIS can be used. The EIs adjust a plant’s airborne and economic impacts from the year 2001 to its mid-year license renewal period based on population increases. These adjustments result in anywhere from a 5 to a 30 percent increase in impacts, depending upon the plant being assessed. Given the range of uncertainty in these types of analyses, a 5 to 30 percent change is not considered significant. Therefore, the effect of increased population around the plant does not generally result in significant increases in impacts.

For initial license renewal, the population used in the North Anna initial license renewal ER (VEPCO 2001-TN8297, Section 4.20) was extrapolated to the year 2030 and found to be 2,468,629. In the SLR ER, As provided in the North Anna ER, the area within a 50-mile (mi) (80 kilometer [km]) radius of the North Anna site totally or partially includes 32 counties and four independent cities within the states of Maryland and Virginia (ER Table E3.11-2). According to the 2010 census, the permanent population (not including transient populations) of the 32 counties and four independent cities was approximately 3,268,359 (ER Table E3.11-2). By 2060, at the end of the proposed SLR term, the permanent population (not including transient populations) of the 32 counties and four independent cities is projected to be approximately 5,069,774. Based on the 2010–2060 population projections, an annual growth rate of approximately 0.96 percent is anticipated for the permanent population within the 50 mi (80 km) radius. Thus, a 20 year growth in population from 2040 to 2060 results in less than a 25 percent increase and is not considered to be a significant increase over a 20-year period. Similarly, the 2013 LR GEIS indicated that a 5 to 30 percent change is not considered significant. Therefore, the effect of increased population around North Anna does not result in a significant impact.

As can be seen from the data in Tables 5.10 and 5.11 of the 1996 LR GEIS, the estimated risk of early and latent fatalities from individual postulated nuclear power plant accidents is SMALL using very conservative 95th-percentile, upper-confidence bound estimates for environmental impact. The early and latent fatalities represent only a small fraction of the risk to which the public is exposed from other sources. As provided in RG 1.174, “An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis,” (NRC 2018-TN6335) the CDF risk metric is used as a surrogate for the individual latent cancer fatality risk, and the LERF risk metric is used as a surrogate for the individual early fatality risk. Given the substantial reduction in the North Anna CDF by a factor of 25, as explained in the PRA internal events section above, and the currently small North Anna LERF value of 1.72×10^{-7}/yr demonstrates that the risk of early and latent fatalities from individual postulated nuclear power plant accidents has decreased since the issuance of the 1996 LR GEIS (NRC 2015-TN8298). Furthermore, as discussed in Section E.3.3 of the 2013 LR GEIS and in this EIS, more recent estimates give significantly lower release frequencies and release fractions for the source term than was assumed in the 1996 LR GEIS. Specifically, the 2013 LR GEIS states that “a comparison of population dose from newer assessments illustrates a reduction in impact by a factor of 5 to 100 when compared to older assessments, and an additional factor of 2 to 4 due to the conservatism built into the 1996 LR GEIS values.” The effect of this reduction in total dose impact far exceeds the effect of a population increase. The staff concludes that the overall effect of increased population around the North Anna nuclear power plant during the SLR period of extended operation does not result in significant increases in impacts. Thus, the staff concludes that no new and significant information exists for North Anna during the SLR term concerning population increases that would alter the conclusions reached in the 1996 LR GEIS,2013 LR GEIS or the North Anna initial LR SEIS.

F.3.10 Summary and Conclusion (Section E.5 of the 2013 LR GEIS)

The 2013 LR GEIS categorizes “sources of new information” by their potential effect on the best-estimate environmental impacts associated with postulated severe accidents. These effects can: (1) decrease the environmental impact associated with severe accidents; (2) not affect the environmental impact associated with severe accidents; or (3) increase the environmental impact associated with severe accidents.

Areas of new and significant information that can result in the first effect (decrease the environmental impacts associated with severe accidents) at North Anna include:

- new internal events information (significant decrease)
- new source term information (significant decrease)

Areas of new and significant information that can result in the second effect (no effect on the environmental impact associated with severe accidents) or the third effect (increase the environmental impact associated with severe accidents) include:

- use of BEIR VII risk coefficients
- consideration of external events
- spent fuel pool accidents (could be comparable to full-power event impacts)
- higher fuel burnup (small increases)
- low power and reactor shutdown events (could be comparable to full-power event impacts)

The 2013 LR GEIS states, "[g]iven the difficulty in conducting a rigorous aggregation of these results with the differences in the information sources utilized, a fairly simple approach is taken." The LR GEIS estimated the net increase from the five areas listed above would be (in a simplistic sense) approximately an increase by a factor of 4.7. At the same time, however, for North Anna, the reduction in risk due to newer internal event information alone is a decrease in risk by a factor of 25. The net effect of an increase by a factor of 4.7 and a decrease by a factor of 25 would be an overall lower estimated impact (as compared to the 1996 LR GEIS assessment) by a factor of 20.3 (25 minus 4.7). Additionally, as described above using North Anna site specific information, the 1996 LR GEIS indicated that the non-normalized predicted total population dose risk (person-rem/RY) (95 percent upper confidence bound) for North Anna 1 and 2 was 1496 person-rem/RY. The population dose risk is equivalent to the probability weighted consequences of a severe accident to the public and environment. The North Anna Units 1 and 2 initial license renewal SAMA total population dose risk was calculated to be 50 person-rem/RY. This provides a ratio of the North Anna 1996 LR GEIS 95 percent upper confidence bound predicted population dose to North Anna initial license renewal total population dose risk of 30. This considerable margin accounts for any increases since the previous North Anna SAMA analysis was conducted. The NRC staff has identified no new and significant information related to severe accidents at North Anna during the SLR term that would alter the conclusions reached in the 1996 LR GEIS, the 2013 LR GEIS, or the North Anna final supplemental environmental impact statement for initial license renewal, that the probability-weighted consequences of severe accidents are SMALL for all nuclear power plants; this applies, as well, for North Anna during the SLR term.

Other areas of new information relating to the North Anna severe accident risk, severe accident environmental impact assessment, and cost-beneficial SAMAs are described below. These areas of new information demonstrate additional conservatism in the evaluations in the LR GEIS and Dominion's ER, because they result in further reductions in the impact of a severe accident.

F.4 Other New Information Related to NRC Efforts to Reduce Severe Accident Risk Following Publication of the 1996 LR GEIS

The Commission considers ways to mitigate severe accidents at a given site more than just in the one-time SAMA analysis associated with a license renewal application. The Commission has considered and adopted various regulatory requirements for mitigating severe accident risks at reactor sites through a variety of NRC programs. For example, in 1996, when it promulgated Table B-1, "Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants," in Appendix B to Subpart A of 10 CFR Part 51-TN250, "Environmental Effect of Renewing the Operating License of a Nuclear Power Plant," the Commission explained in a *Federal Register* notice:

> The Commission has considered containment improvements for all plants pursuant to its Containment Performance Improvement program…and the Commission has additional ongoing regulatory programs whereby licensees search for individual plant vulnerabilities to severe accidents and consider cost-beneficial improvements (Final rule, "Environmental Review for Renewal of Nuclear Power Plant Operating Licenses," 61 FR 28467-TN4491 (June 5, 1996)).

These "additional ongoing regulatory programs" that the Commission mentioned include the IPE and the IPEEE program, which consider "potential improvements to reduce the frequency or consequences of severe accidents on a nuclear power plant-specific basis and essentially constitute a broad search for severe accident mitigation alternatives." Further, in the same rule, the Commission observed that the IPEs "resulted in a number of plant procedural or programmatic improvements and some plant modifications that will further reduce the risk of severe accidents" (61 FR 28481-TN8474) [*Federal Register* notices are accessible and searchable at https://www.federalregister.gov]. Based on these and other considerations, the Commission stated its belief that it is "unlikely that any site-specific consideration of SAMAs for license renewal will identify major plant design changes or modifications that will prove to be cost-beneficial for reducing severe accident frequency or consequences." The Commission noted that it may review and possibly reclassify the issue of severe accident mitigation as a Category 1 issue upon the conclusion of its IPE/IPEEE program but deemed it appropriate to consider SAMAs for nuclear power plants for which it had not done so previously, pending further rulemaking on this issue.

The Commission reaffirmed its SAMA-related conclusions in Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 and 10 CFR 51.53(c)(3)(ii)(L), "Postconstruction environmental reports," in *Exelon Generation Co., LLC* (Limerick Generating Station, Units 1 and 2), CLI-13-07, (October 31, 2013). In addition, the Commission observed that it had promulgated those regulations because it had "determined that one SAMA analysis would uncover most cost-beneficial measures to mitigate both the risk and the effects of severe accidents, thus satisfying our obligations under NEPA" (NRC 2013-TN7766).

The NRC has continued to address severe accident-related issues since the agency published the LR GEIS in 1996. Combined NRC and licensee efforts have reduced risks from accidents beyond those accidents that were considered in the 1996 LR GEIS. The 2013 LR GEIS describes many of those efforts (NRC 2013-TN2654).

These improvements and the Commission's conclusions apply to reactor operations at any time during a plant's life, whether under an initial operating license, initial license renewal, or SLR. In the remainder of Section F.4 of this site-specific EIS, the NRC staff describes several efforts to reduce severe accident risk (i.e., CDF and LERF) following publication of the 1996 LR GEIS. Each of these initiatives applies to all reactors at any time during reactor operations, including North Anna during the SLR term. Section F.4.1 describes requirements adopted following the terrorist attacks of September 11, 2001, to address the loss of large areas of a nuclear power plant caused by fire or explosions. Section F.4.2 describes the SOARCA project, which indicates that source term timing and magnitude values may be significantly lower than source term values quantified in previous studies using other analysis methods. Section F.4.3 describes measures adopted following the Fukushima earthquake and tsunami events of 2013. Section F.4.4 discusses efforts that have been made to use nuclear power plant operating experience to improve nuclear power plant performance and design features. These are areas of new information that reinforce the conclusion that the probability-weighted consequences of severe accidents are SMALL for all nuclear power plants, as stated in the 2013 LR GEIS and the North Anna final supplemental environmental impact statement for initial license renewal, and further reduce the likelihood of finding a cost-beneficial SAMA that would substantially reduce the severe accident risk at North Anna during the SLR term.

F.4.1 10 CFR 50.54(hh)(2) Requirements Regarding Loss of Large Areas of the Nuclear Power Plant Caused by Fire or Explosions

As discussed on page E-7 of the 2013 LR GEIS, following the terrorist attacks of September 11, 2001, the NRC conducted a comprehensive review of the agency's security program and made further enhancements to security at a wide range of NRC-regulated facilities. These enhancements included significant reinforcement of the defense capabilities for nuclear facilities, better control of sensitive information, enhancements in emergency preparedness, and implementation of mitigating strategies to deal with postulated events potentially causing loss of large areas of the nuclear power plant due to explosions or fires, including those that an aircraft impact might create. For example, the Commission issued Order EA-02-026, "Order for interim safeguards and security compensatory measures" (NRC 2002-TN7825) to provide interim safeguards and security compensatory measures, which ultimately led to the promulgation of a new regulation in 10 CFR 50.54(hh) (TN249). This regulation requires commercial power reactor licensees to prepare for a loss of large areas of the facility due to large fires and explosions from any cause, including beyond-design-basis aircraft impacts. In accordance with 10 CFR 50.54(hh)(2), licensees must adopt guidance and strategies to maintain or restore core cooling, containment, and spent-fuel pool cooling capabilities under circumstances associated with the loss of large areas of the nuclear power plant due to explosion or fire (NRC 2013-TN2654; 10 CFR Part 50-TN249).

NRC requirements pertaining to nuclear power plant security are subject to NRC oversight on an ongoing basis under a nuclear power plant's current operating license and are beyond the scope of license renewal. As discussed in Section 5.3.3.1 of the 1996 LR GEIS, the NRC addresses security-related events using deterministic criteria in 10 CFR Part 73 (TN423), "Physical Protection of Plants and Materials," rather than by risk assessments or SAMAs. However, the implementation of measures that reduce the risk of severe accidents, including measures adopted to comply with 10 CFR 50.54(hh), "Conditions of licenses," also have a beneficial impact on the level of risk evaluated in a SAMA analysis, the purpose of which is to identify potentially cost-beneficial design alternatives, procedural modifications, or training activities that may further reduce the risks of severe accidents. Dominion has updated North Anna's guidelines, strategies, and procedures to meet the requirements of 10 CFR 50.54(hh); therefore, those efforts have contributed to mitigation of the risk of a beyond-design-basis event. Accordingly, actions taken by Dominion to comply with those regulatory requirements have further contributed to the reduction of risk at North Anna.

In sum, the new information regarding actions that Dominion has taken to prepare for potential loss of large areas of the nuclear power plant due to fire or explosions has further contributed to the reduction of severe accident risk at North Anna, including during SLR operations. Thus, this information does not alter the conclusions reached in the 2013 LR GEIS regarding the probability-weighted consequences of severe accidents for North Anna SLR.

F.4.2 State-of-the-Art Reactor Consequence Analysis

The 2013 LR GEIS notes that a significant NRC effort is ongoing to re-quantify realistic, severe-accident source terms under the SOARCA project. Results indicate that source-term timing and magnitude values quantified using SOARCA are significantly lower than source-term values quantified in previous studies using other analysis methods (NRC 2008-TN8380). The NRC staff plans to incorporate this new information regarding source term timing and magnitude using SOARCA in future revisions of the LR GEIS (NRC 2013-TN2654).

The NRC has completed a SOARCA study for Surry, which like North Anna is a Westinghouse PWR with a large containment, located in close proximity to North Anna (NRC 2013-TN4593). The Surry SOARCA analyses indicate that successful implementation of existing mitigation measures can prevent reactor core damage or delay or reduce offsite releases of radioactive material. All SOARCA scenarios, even when unmitigated, progress more slowly and release much less radioactive material than the potential releases cited in the 1982 Siting Study, NUREG/CR-2239, *Technical Guidance for Siting Criteria Development* (Aldrich et al. 1982-

TN7749). As a result, the calculated risks of public health consequences of severe accidents modeled in SOARCA are very small.

This new information regarding the SOARCA project's findings has further contributed to the likelihood of a reduction of the calculated severe accident risk at North Anna, as compared to the 1996 LR GEIS and the North Anna SAMA evaluation for the initial license renewal application in 2001. the NRC staff finds there is no new and significant information related to the SOARCA project that would alter the conclusions reached in the 2013 LR GEIS or North Anna's previous SAMA analysis for North Anna operations during the SLR term.

F.4.3 Fukushima-Related Activities

As discussed in Section E.2.1 of the 2013 LR GEIS, on March 11, 2011, a massive earthquake off the east coast of the main island of Honshu, Japan, produced a tsunami that struck the coastal town of Okuma in Fukushima Prefecture. The resulting flooding damaged the six-unit Fukushima Dai-ichi nuclear power plant, causing the failure of safety systems needed to maintain cooling water flow to the reactors. Due to the loss of cooling, the fuel overheated, and there was a partial meltdown of fuel in three of the reactors. Damage to the systems and structures containing reactor fuel resulted in the release of radioactive material to the surrounding environment (NRC 2013-TN2654).

As further discussed in Section E.2.1 of the 2013 LR GEIS, in response to the earthquake, tsunami, and resulting reactor accidents at Fukushima Dai-ichi (hereafter referred to as the Fukushima events), the Commission directed the NRC staff to convene an agency task force of senior leaders and experts to conduct a methodical and systematic review of NRC regulatory requirements, programs, and processes (and their implementation) relevant to the Fukushima events. After thorough evaluation, the NRC required significant enhancements to U.S. commercial nuclear power plants. The enhancements included: adding capabilities to maintain key nuclear power plant safety functions following a large-scale natural disaster; updating evaluations on the potential impact from seismic and flooding events; adding new equipment to better handle potential reactor core damage events; and strengthening emergency coping capabilities. Additional discussion specific to the North Anna response to earthquakes, including Dominion's performance of a Seismic PRA, is available above in Section F.3.2 and Section 3.4.4 of this EIS.

In summary, the Commission has imposed additional safety requirements on operating reactors, including North Anna, following the Fukushima accident (as described in the preceding paragraphs). The new regulatory requirements have further contributed to the reduction of severe accident risk at North Anna. Further, these additional requirements apply to reactor operations at any time during a plant's life, whether under an initial operating license, initial license renewal, or SLR The NRC staff concludes that there is no new and significant information related to the Fukushima events that would alter the conclusions reached in n the 2013 LR GEIS or North Anna's previous SAMA analysis, as applicable to North Anna operations during the SLR term.

F.4.4 Operating Experience

Section E.2 of the 2013 LR GEIS mentions the considerable operating experience that supports the safety of U.S. nuclear power plants. As with the use of any technology, greater user experience generally leads to improved performance and improved safety. Additional operating experience at nuclear power plants has contributed to improved nuclear power plant performance (e.g., as measured by trends in nuclear power plant-specific performance indicators), a reduction in adverse operating events, and new lessons learned that improve the safety of all operating nuclear power plants (NRC 2013-TN2654).

F.4.5 Conclusion

In sum, the new information related to NRC efforts to reduce severe accident risk described above contribute to improved safety, as do safety improvements not related to license renewal, including the NRC and industry response to generic safety issues (NRC 2011-TN7816). The performance and safety record of nuclear power plants operating in the United States, including North Anna, continue to improve. This improvement is also confirmed by analysis, which indicates that, in many cases, improved nuclear power plant performance and design features have resulted in reductions in initiating event frequency, CDF, and containment failure frequency (NRC 2013-TN2654).

As discussed above, the NRC and the nuclear industry have addressed and continue to address numerous severe accident-related issues since the publication of the 1996 LR GEIS and the 2001 North Anna SAMA analysis performed at the time of initial license renewal. These actions reinforce the conclusion that the probability-weighted consequences of severe accidents are SMALL for all nuclear power plants, as stated in the 2013 LR GEIS, and further reduce the likelihood of finding a cost-beneficial SAMA that would substantially reduce the severe accident risk at North Anna during the SLR term.

F.5 Evaluation of New and Significant Information Pertaining to SAMAs Using NEI 17-04, "Model SLR New and Significant Assessment Approach for SAMA"

In its evaluation of the significance of new information, the NRC staff considers that new information is significant if it provides a seriously different picture of the impacts of the Federal action under consideration. Thus, for mitigation alternatives such as SAMAs, new information is significant if it indicates that a mitigation alternative would substantially reduce an impact of the Federal action on the environment. Consequently, with respect to SAMAs, new information may be significant if it indicates a given potentially cost-beneficial SAMA would substantially reduce the impacts of a severe accident or the probability or risk of a severe accident occurring (NRC 2013-TN2654).

As discussed earlier in Section F.2.2, Dominion stated in its ER (submitted as part of its SLR application), that it used the methodology in NEI 17-04 Revision 1, "Model SLR New and Significant Assessment Approach for SAMA" (NEI 2019-TN6815) to evaluate new and significant information as it relates to the North Anna SLR SAMAs. By letter dated December 11, 2019, the staff reviewed NEI 17-04 and found it acceptable for interim use, pending formal NRC endorsement of NEI 17-04 by incorporation in RG 4.2, Supplement 1, "Preparation of Environmental Reports for Nuclear Power Plant License Renewal Applications" (NRC 2019). In general, as discussed earlier, the NEI 17-04 methodology (NEI 2017-TN8338) does not consider a potential SAMA to be significant unless it reduces by at least 50 percent the maximum benefit as defined in Section 4.5, "Total Cost of Severe Accident Risk/Maximum Benefit," of NEI 05-01, Revision A, "Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document." NEI 05-01 is endorsed in NRC RG 4.2, Supplement 1 (NRC 2013-TN2654).

NEI 17-04, “Model SLR New and Significant Assessment Approach for SAMA,” describes a three-stage process for determining whether there is any new and significant information relevant to a previous SAMA analysis.

Stage 1: The SLR applicant uses PRA risk insights and/or risk model quantifications to estimate the percent reduction in the maximum benefit associated with: (1) all unimplemented “Phase 2” SAMAs for the analyzed nuclear power plant; and (2) those SAMAs identified as potentially cost-beneficial for other U.S. nuclear power plants and which are applicable to the analyzed nuclear power plant. If one or more of those SAMAs are shown to reduce the maximum benefit by 50 percent or more, then the applicant must complete Stage 2. (Applicants that demonstrate through the Stage 1 screening process that there is no potentially significant new information are not required to perform the Stage 2 or Stage 3 assessments.)

Stage 2: The SLR applicant develops updated averted cost-risk estimates for implementing those SAMAs. If the Stage 2 assessment confirms that one or more SAMAs reduce the maximum benefit by 50 percent or more, then the applicant must complete Stage 3.

Stage 3: The SLR applicant performs a cost-benefit analysis for the “potentially significant” SAMAs identified in Stage 2.

Upon completion of the Stage 1 screening process, Dominion determined that there is no potentially significant new information affecting its North Anna SAMA analysis; thus, Dominion did not perform the Stage 2 or Stage 3 assessments. The following sections summarize Dominion’s application of the NEI 17-04 methodology to North Anna SAMAs.

F.5.1 Data Collection

NEI 17-04 Section 3.1, “Data Collection,” explains that the initial step of the assessment process is to identify the “new information” relevant to the SAMA analysis and to collect and develop those elements of information that will be used to support the assessment. The guidance document states that each applicant should collect, develop, and document the information elements corresponding to the stage or stages of the SAMA analysis performed for the site. For North Anna SLR, the NRC staff reviewed the onsite information during an audit at NRC headquarters and determined that Dominion had considered the appropriate information (NRC 2020-TN8100).

F.5.2 Stage 1 Assessment

Section E4.15.3, “Methodology for Evaluation of New and Significant SAMAs,” of Dominion’s ER describes the process it used to identify any potentially new and significant SAMAs from the 2001 SAMA analysis (VEPCO 2020-TN8099). In Stage 1 of the process, Dominion used PRA risk insights and/or risk model quantifications to estimate the percent reduction in the maximum benefit associated with the following two types of SAMAs:

- all unimplemented “Phase 2” SAMAs for North Anna
- those SAMAs identified as potentially cost-beneficial for other U.S. nuclear power plants and that are applicable to North Anna (VEPCO 2020-TN8099)

F.5.3 Dominion's Evaluation of Unimplemented North Anna "Phase 2" SAMAs

In 2001, Dominion submitted an application for initial operating license renewal (VEPCO 2001-TN8297), which the NRC approved in 2002 as described above in Section F.2.1. As part of the SLR, Dominion examined its initial license renewal SAMA analysis and the North Anna PRA again, for insights. The purpose was to determine if there was any new and significant information regarding the SAMA analyses that were performed for initial renewal of the North Anna operating licenses. Dominion reevaluated the 51 SAMAs that were considered to be "Phase 2" in connection with initial license renewal, using the NEI 17-04 process.

The list of SAMAs collected was evaluated qualitatively to screen any that are not applicable to North Anna or already exist at North Anna. The remaining SAMAs were then grouped (if similar) based on similarities in mitigation equipment or risk reduction benefits, and all were evaluated for the impact they have on the North Anna CDF and source term category frequencies if implemented. In addition, two other screening criteria were applied to eliminate SAMAs that have excessive cost. First, SAMAs were screened out if they were found to reduce the North Anna maximum benefit by greater than 50 percent in the initial North Anna license renewal but were found not to be cost-effective due to high cost in the initial license renewal analysis. Second, SAMAs related to creating a containment vent were screened out because this nuclear power plant modification has been evaluated industrywide and explicitly found to not be cost-effective in Westinghouse large/dry containments. If any of the SAMAs were found to reduce the total CDF or at least one consequential source term category frequency by at least 50 percent, then the SAMA was retained for a Stage 2 assessment (Level 3 PRA evaluation of the reduction in maximum benefit). As discussed below, all SAMAs were screened out as not significant without the need to go to the Stage 2 assessment or PRA Level 3 evaluation.

F.5.4 Dominion's Evaluation of SAMAs Identified as Potentially Cost-Beneficial at Other U.S. Nuclear Power Plants that Are Applicable to North Anna

Dominion reviewed the SEISs of nuclear power plants with a similar design to North Anna (PWR Large/Dry Containments), resulting in the identification of 283 potentially cost-beneficial SAMAs from other nuclear power plants. This large list of industry SAMAs was qualitatively screened using the criteria that a potential SAMA is not applicable to the North Anna design or the SAMA has already been implemented at North Anna. Dominion grouped the remaining SAMAs based on similarities in mitigation equipment or risk reduction benefits. Thus, Dominion evaluated 51 North Anna-specific SAMAs and 283 potentially cost-beneficial SAMAs identified at similarly designed nuclear power plants (industry SAMAs) for a total of 334 SAMAs.

Section E4.15.4 of Dominion's SLR ER provides an evaluation using the methodology in NEI 17-04, "Model SLR New and Significant Assessment Approach for SAMA." The industry SAMAs that were not qualitatively screened out were then merged with the North Anna-specific SAMAs collected from initial license renewal, with similar SAMAs grouped together for further analysis. The combined SAMA list was then quantitatively screened to determine if the CDF or any source term category frequency would be reduced at least 50 percent if the SAMA was implemented. Table E4.15-1 of the ER presents the 39 industry SAMAs that were not qualitatively screened out, combined with the 51 North Anna-specific SAMAs selected for further evaluation. Table E4.15-2 presents the quantitative screening results from the bounding SAMA evaluations. As seen in Table E4.15-2, none of the bounding quantitative screening evaluations resulted in a reduction of total CDF, total LERF, or total large release frequency (LRF) greater than 50 percent. Of the results presented in Table E4.15-2, one case (labeled as emergency diesel generator ("EDG")) yielded an internal events. LLRF (Large Late Release Frequency) reduction of 57 percent. However, Dominion explained that the total change in the Maximum Benefit for the EDG case is well below 50 percent. Since Dominion's Stage 1 analysis demonstrated that none of the SAMAs considered for quantitative evaluation would reduce the North Anna maximum benefit by 50 percent or greater, Dominion concluded that no new and significant information relevant to the original SAMA analysis for North Anna exists, and no further analysis is needed.

The NRC staff reviewed North Anna's onsite information and its SAMA Stage 1 process during an in-office audit at NRC headquarters (NRC 2020-TN8100 see Appendix D). The staff found that Dominion had used a methodical and reasonable approach to identify any SAMAs that might reduce the maximum benefit by at least 50 percent and therefore could be considered potentially significant. The NRC staff finds that Dominion properly concluded, in accordance with the NEI 17-04 guidance, that it did not need to conduct a Stage 2 assessment.

F.5.5 Other New Information

As discussed in Dominion's SLR application ER and in NEI 17-04, there are some inputs to the SAMA analysis that are expected to change or to potentially change for all nuclear power plants. Examples of these inputs include the following:

- Updated Level 3 PRA model consequence results, which may be impacted by multiple inputs, including, but not limited to, the following:
  - population, as projected within a 50 mi (80 km) radius of the nuclear power plant
  - value of farm and nonfarm wealth
  - core inventory (e.g., due to power uprate)
  - evacuation timing and speed
  - Level 3 PRA methodology updates
  - cost-benefit methodology updates

In addition, other changes that could be considered new information may be dependent on nuclear power plant activities or site-specific changes. These types of changes (listed in NEI 17-04) include the following:

- Identification of a new hazard (e.g., a fault that was not previously analyzed in the seismic analysis).
  - Updated nuclear power plant risk model (e.g., a fire PRA that replaces the IPEEE analysis).
- Impacts of nuclear power plant changes that are included in the nuclear power plant risk models will be reflected in the model results and do not need to be assessed separately.
- Nonmodeled modifications to the nuclear power plant.
  - Modifications determined to have no risk impact need not be included (e.g., replacement of the condenser vacuum pumps), unless they impact a specific input to SAMA (e.g., new low-pressure turbine in the power conversion system that results in a greater net electrical output).

The NEI methodology described in NEI 17-04 uses “maximum benefit” to determine if SAMA - related information is new and significant. Maximum benefit is defined in Section 4.5 of NEI 05-01, Revision A, “Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document” (NEI 2005-TN1978), as the benefit a SAMA could achieve if it eliminated all risk. The total offsite dose and total economic impact are the baseline risk measures from which the maximum benefit is calculated. The methodology in NEI 17-04 considers a cost-beneficial SAMA to be potentially significant if it reduces the maximum benefit by at least 50 percent. The NRC staff finds the criterion of exceeding a 50-percent reduction in the maximum benefit a reasonable significance value because it correlates with significance determinations in the American Society of Mechanical Engineers and American Nuclear Society PRA standard (cited in RG 1.200) (ASME/ANS 2009-TN6220; NRC 2009-TN6211), NUMARC 93-01, “Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants” (NRC endorsed in RG 1.160) (NEI 2018-TN7758; NRC 2018-TN7799) and NEI 00-04, “10 CFR 50.69 SSC Categorization Guideline” (endorsed in RG 1.201) (NEI 2005-TN8340; NRC 2006-TN6279), which the NRC has cited or endorsed. It is also a reasonable quantification of the qualitative criteria that new information is significant if it presents a seriously different picture of the impacts of the Federal action under consideration, requiring a supplement (NUREG-0386, *United States Nuclear Regulatory Commission Staff Practice and Procedure Digest: Commission, Appeal Board, and Licensing Board Decisions* [NRC 2009-TN8377]). Furthermore, it is consistent with the criteria that the NRC staff accepted in the Limerick Generating Station license renewal final SEIS (NRC 2014-TN7328). The NRC staff finds the approach in NEI 17-04 to be reasonable because, with respect to SAMAs, new information may be significant if it indicates a potentially cost-beneficial SAMA could substantially reduce the probability or consequences (risk) of a severe accident occurring. The implication of this statement is that “significance” is not solely related to whether a SAMA is cost-beneficial (which may be affected by economic factors, increases in population, etc.), but it also depends on a SAMA’s potential to significantly reduce risk to the public.

F.5.6 Conclusion

The NRC staff reviewed Dominion’s new and significant information analysis for severe accidents and SAMAs at North Anna during the SLR period and finds Dominion’s analysis and methods to be reasonable. As described above, Dominion evaluated a total of 334 SAMAs for North Anna SLR and did not find any SAMAs that would reduce the maximum benefit by 50 percent or more. The NRC staff reviewed Dominion’s evaluation and concludes that Dominion’s methods and results were reasonable. Based on North Anna’s Stage 1 qualitative and quantitative screening results, Dominion demonstrated that none of the nuclear power plant-specific and industry SAMAs that it considered constitute new and significant information in that none changed the conclusion of North Anna’s previous SAMA analysis. Further, the NRC staff did not otherwise identify any new and significant information that would alter the conclusions reached in the previous SAMA analysis for North Anna. Therefore, the NRC staff concludes that there is no new and significant information that would alter the conclusions of the SAMA analysis performed for North Anna’s initial license renewal.

In addition, given the low residual risk at North Anna, the substantial decrease in internal event CDF at North Anna from the previous SAMA analysis, and the fact that no potentially cost-beneficial SAMAs were identified during North Anna’s initial license renewal review, the staff considers it unlikely that Dominion would have found any potentially cost-beneficial SAMAs for North Anna SLR. Further, Dominion’s implementation of actions to satisfy the NRC’s orders and regulatory requirements regarding beyond-design-basis events after the September 2001 terrorist attacks and the March 2011 Fukushima events, including Dominion’s performance of a seismic PRA, as well as the conservative assumptions used in earlier severe accident studies and SAMA analyses, also make it unlikely that Dominion would have found any potentially significant cost-beneficial SAMAs during its SLR review. For all the reasons stated above, the NRC staff concludes that Dominion reached reasonable SAMA conclusions in its SLR ER and that there is no new and significant information regarding any potentially cost-beneficial SAMA that would substantially reduce the risks of a severe accident at North Anna during the SLR term.

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APPENDIX G

ENVIRONMENTAL ISSUES AND IMPACT FINDINGS CONTAINED IN THE PROPOSED RULE, 10 CFR PART 51, "ENVIRONMENTAL PROTECTION REGULATIONS FOR DOMESTIC LICENSING AND RELATED REGULATORY FUNCTIONS"

The U.S. Nuclear Regulatory Commission (NRC, the Commission) staff prepared this site-specific environmental impact statement (EIS) to evaluate the environmental impacts of subsequent license renewal (SLR) for North Anna Power Station, Units 1 and 2 (North Anna), operated by Dominion Electric and Power Company, doing business as Dominion Energy Virginia (Dominion).

This EIS includes the NRC staff's site-specific evaluation of the environmental impacts of SLR for North Anna for each of the environmental issues that were dispositioned as Category 1 issues (i.e., generic to all or a distinct subset of nuclear power plants) in the staff's draft supplemental environmental impact statement (DSEIS).[1] The DSEIS had been issued as a supplement to NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants," Revision 1, Final Report (the 2013 License Renewal Generic Environmental Impact Statement [LR GEIS]; NRC 2013). The 2013 LR GEIS and the associated revised rule (78 *Federal Register* [FR] 37282) had identified 78 environmental impact issues, 61 of which were deemed to be generic Category 1 issues and 17 of which were deemed to be Category 2 issues that required a plant-specific analysis. The DSEIS followed that approach, consistent with Table B–1 in Appendix B to Subpart A of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51, "Environmental protection regulations for domestic licensing and related regulatory functions."

In accordance with the Commission's decisions in Commission Legal Issuance (CLI)-22-02 and CLI-22-03, this EIS provides a site-specific evaluation of the issues that were treated as Category 1 issues in the DSEIS. This EIS also updates and considers new information concerning Category 2 issues (specific to individual nuclear power plants) in the DSEIS. This EIS evaluates, on a site-specific basis, all of the environmental impacts of continued operation for North Anna Units 1 and 2 during the SLR term. Thus, this EIS supersedes in its entirety the August 2021 DSEIS. On March 3, 2023, the NRC published a draft rule (88 FR 13329-TN8601) proposing to amend its environmental protection regulations in 10 CFR Part 51 (TN250). Specifically, the proposed rule would update the NRC's 2013 findings concerning the environmental impacts of renewing the operating license of a nuclear power plant and specifically addresses SLR. The technical basis for the proposed rule would be provided by Revision 2 to NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (the 2023 LR GEIS; NRC 2023-TN7802), which would update NUREG-1437, Revision 1 (the 2013 LR GEIS NRC 2013-TN2654), which, in turn, was an update of NUREG-1437, Revision 0 (the 1996 LR GEIS; NRC 1996-TN288). The 2023 LR GEIS would specifically support the proposed revised list of National Environmental Policy Act of 1969, as amended, issues and associated environmental impact findings for license renewal (including SLR) to be contained in Table B-1 in Appendix B to Subpart A of 10 CFR Part 51 (TN250). The 2023 LR

[1] "Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 7, Second Renewal, Regarding Subsequent License Renewal for North Anna Power Station Units 1 and 2, Draft Report for Comment" (NUREG-1437, Supplement 7, Second Renewal) (DSEIS) (NRC 2021-TN7294) issued in August 2021.

GEIS and proposed rule reflect lessons learned and knowledge gained from the NRC's conducting of environmental reviews for initial license renewal and SLR since 2013.

The proposed rule would redefine the number and scope of the environmental issues that must be addressed by the NRC during initial license renewal and SLR environmental reviews. The proposed rule identifies 80 environmental impact issues, 20 of which would require plant-specific analyses. The proposed rule would reclassify some previously site-specific (Category 2) issues as generic (Category 1) issues and would consolidate other issues. It would also add new Category 1 and Category 2 issues to Table B-1. In Section 1.10 of the 2023 proposed LR GEIS, these proposed changes are summarized as follows.

- One Category 2 issue, "Groundwater quality degradation (cooling ponds at inland sites)," and a related Category 1 issue, "Groundwater quality degradation (cooling ponds in salt marshes)," would be consolidated into a single Category 2 issue, "Groundwater quality degradation (plants with cooling ponds)."
- Two related Category 1 issues, "Infrequently reported thermal impacts (all plants)" and "Effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication," and the thermal effluent component of the Category 1 issue, "Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses," would be consolidated into a single Category 1 issue, "Infrequently reported effects of thermal effluents."
- One Category 2 issue, "Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds)," and the impingement component of the Category 1 issue, "Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses," would be consolidated into a single Category 2 issue, "Impingement mortality and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds)."
- One Category 1 issue, "Impingement and entrainment of aquatic organisms (plants with cooling towers)," and the impingement component of the Category 1 issue, "Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses," would be consolidated into a single Category 1 issue, "Impingement mortality and entrainment of aquatic organisms (plants with cooling towers)."
- One Category 2 issue, "Threatened, endangered, and protected species and essential fish habitat," would be divided into three Category 2 issues: (1) "Endangered Species Act: federally listed species and critical habitats under U.S. Fish and Wildlife jurisdiction," (2)"Endangered Species Act: federally listed species and critical habitats under National Marine Fisheries Service jurisdiction," and (3) "Magnuson-Stevens Act: essential fish habitat."
- Two new Category 2 issues, "National Marine Sanctuaries Act: sanctuary resources" and "Climate change impacts on environmental resources," would be added.
- One Category 2 issue, "Severe accidents," would be changed to a Category 1 issue.
- One new Category 1 issue, "Greenhouse gas impacts on climate change," would be added.

Several issue titles and findings would be revised to clarify their intended meanings. The final versions of the 2023 LR GEIS and the proposed rule are expected to be published in August 2024 and, upon being finalized, the NRC's environmental protection regulations would be revised. Thereafter, the NRC would have to consider and analyze in its initial license renewal and SLR environmental reviews, any potential significant impacts associated with the Category

2 issues and, to the extent that there is any new and significant information, the potential significant impacts associated with the Category 1 issues. In order to account for the proposed rule and 2023 LR GEIS and the possibility that the proposed rule and revised LR GEIS may be finalized in 2024, before a final determination is reached on the North Anna SLR application, the NRC staff analyzes in this appendix the new and revised environmental issues as they may apply to SLR for North Anna. Table G-1 lists the new and revised environmental issues that would apply to North Anna SLR. The sections that follow discuss how the NRC staff addressed each of these new and revised issues in this site-specific EIS and explains the NRC staff's conclusion that this EIS covers all the issues in the proposed rule and 2023 LR GEIS.

Table G-1 New and Revised 10 CFR Part 51 License Renewal Environmental Issues

Issue	2023 LR GEIS Section	Category
Infrequently reported effects of thermal effluents	4.6.1.2	1
Impingement mortality and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds)	4.6.1.2	2
Endangered Species Act: federally listed species and critical habitats under U.S. Fish and Wildlife jurisdiction	4.6.1.3.1	2
Endangered Species Act: federally listed species and critical habitats under National Marine Fisheries Service jurisdiction	4.6.1.3.2	2
Magnuson-Stevens Act: essential fish habitat	4.6.1.3.3	2
National Marine Sanctuaries Act: sanctuary resources	4.6.1.3.4	2
Severe accidents	4.9.1.2.1	1
Greenhouse gas impacts on climate change	4.12.1	1
Climate change impacts on environmental resources	4.12.3	2

G.1 Infrequently Reported Effects of Thermal Effluents

The draft rule proposes to combine two Category 1 issues, "Infrequently reported thermal impacts (all plants)" and "Effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication," and the thermal effluent component of the Category 1 issue, "Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses," into one Category 1 issue, "Infrequently reported effects of thermal effluents." This issue pertains to interrelated and infrequently reported effects of thermal effluents, including cold shock, thermal migration barriers, accelerated maturation of aquatic insects, and proliferated growth of aquatic nuisance species, as well as the effects of thermal effluents on dissolved oxygen, gas supersaturation, and eutrophication. This issue also considers sublethal stresses associated with thermal effluents that can increase the susceptibility of exposed organisms to predation, parasitism, or disease. These changes do not introduce any new environmental issues; rather, the proposed rule would reorganize existing issues. The changes are fully summarized and explained in Section 4.6.1.2 of the 2023 LR GEIS and in the proposed rule.

Sections 3.7.3.4, 3.7.3.5, and 3.7.3.11 of this EIS analyze infrequently reported effects of thermal effluents for North Anna SLR and conclude that the impacts would be SMALL. Therefore, the environmental issue of infrequently reported effects of thermal effluents is addressed in this EIS.

G.2 Impingement Mortality and Entrainment of Aquatic Organisms (Plants with Once-Through Cooling Systems or Cooling Ponds)

The draft rule proposes to combine the Category 2 issue, “Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds),” and the impingement component of the Category 1 issue, “Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses,” into one Category 2 issue, “Impingement mortality and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds).” This issue pertains to impingement mortality and entrainment of finfish and shellfish at nuclear power plants with once-through cooling systems and cooling ponds during the license renewal term (either initial license renewal or SLR). This includes plants with helper cooling towers that are seasonally operated to reduce thermal load to the receiving water body, reduce entrainment during peak spawning periods, or reduce consumptive water use during periods of low river flow.

In the 2023 LR GEIS, the NRC renamed this issue to specify impingement mortality, rather than simply impingement. This change is consistent with the U.S. Environmental Protection Agency (EPA) 2014 Clean Water Act Section 316(b) regulations and the EPA’s assessment that impingement reduction technology is available, feasible, and has been demonstrated to be effective. Additionally, the EPA 2014 Clean Water Act Section 316(b) regulations establish best technology available standards for impingement mortality based on the fact that survival is a more appropriate metric for determining environmental impact rather than simply looking at total impingement. Therefore, the 2023 LR GEIS also consolidates the impingement component of the “Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses” issue for plants with once-through cooling systems or cooling ponds into this issue.

Section 3.7.3.1 of this EIS analyzes the impacts of impingement and entrainment for North Anna SLR. The analysis considers the components of the proposed revision to this issue, impingement mortality, and the impingement component of losses from predation, parasitism, and disease among organisms exposed to sublethal stresses. In this section, the NRC staff concludes that impingement and entrainment during the SLR term would be of SMALL significance on the aquatic organisms in Lake Anna. Therefore, the environmental issue of impingement mortality and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds) is addressed in this EIS.

G.3 Endangered Species Act: Federally Listed Species and Critical Habitats Under U.S. Fish and Wildlife Jurisdiction

The draft rule proposes to divide the Category 2 issue, “Threatened, endangered, and protected species and essential fish habitat,” into three separate Category 2 issues for clarity and consistency with the separate Federal statues and interagency consultation requirements that the NRC must consider with respect to federally protected ecological resources. When combined, however, the scope of the three issues is the same as the scope of the former “Threatened, endangered, and protected species and essential fish habitat” issue discussed in the 2013 LR GEIS. As discussed in this section, as well as Sections G.4 and G.5 below, such impacts were considered in this EIS.

The first of the three issues, “Endangered Species Act: federally listed species and critical habitats under U.S. Fish and Wildlife jurisdiction,” concerns the potential effects of continued nuclear power plant operation and any refurbishment during the license renewal term on federally listed species and critical habitats protected under the Endangered Species Act (ESA) and under the jurisdiction of the U.S. Fish and Wildlife Service (FWS).

Sections 3.8.1 and 3.8.4 of this EIS addresses the impacts of North Anna SLR on federally listed species and critical habitats under FWS jurisdiction. The NRC staff determined that North Anna SLR may affect but is not likely to adversely affect the northern long-eared bat, tricolored bat, and monarch butterfly. Appendix C.1 describes the staff's ESA consultation with the FWS. Therefore, the environmental issue of Endangered Species Act: federally listed species and critical habitats under FWS jurisdiction is addressed in this EIS.

G.4 Endangered Species Act: Federally Listed Species and Critical Habitats Under National Marine Fisheries Service Jurisdiction

As explained in the previous section, the draft rule proposes to divide the Category 2 issue, "Threatened, endangered, and protected species and essential fish habitat," into three separate Category 2 issues. The second of the three issues, "Endangered Species Act: federally listed species and critical habitats under National Marine Fisheries Service jurisdiction," concerns the potential effects of continued nuclear power plant operation and any refurbishment during the license renewal term on federally listed species and critical habitats protected under the ESA and under the jurisdiction of the National Marine Fisheries Service.

Section 3.8.1 and 3.8.4 of this EIS find that no federally listed species or critical habitats under National Marine Fisheries Service jurisdiction occur within the action area. Accordingly, the NRC staff concluded that the proposed action would have no effect on federally listed species or habitats under National Marine Fisheries Service jurisdiction. Therefore, the environmental issue of Endangered Species Act: federally listed species and critical habitats under National Marine Fisheries Service jurisdiction is addressed in this EIS.

G.5 Magnuson-Stevens Act: Essential Fish Habitat

As explained above, the draft rule proposes to divide the Category 2 issue, "Threatened, endangered, and protected species and essential fish habitat," into three separate Category 2 issues. The third of the three issues, "Magnuson-Stevens Act: essential fish habitat," concerns the potential effects of continued nuclear power plant operation and any refurbishment during the license renewal term on essential fish habitat protected under the Magnuson-Stevens Act.

Sections 3.8.2 and 3.8.5 of this EIS find that no essential fish habitat occurs within the affected area. Accordingly, the NRC staff concluded that the proposed action would have no effect on essential fish habitats. Therefore, the environmental issue of Magnuson-Stevens Act: essential fish habitat is addressed in this EIS.

G.6 National Marine Sanctuaries Act: Sanctuary Resources

The draft rule proposes to add a new Category 2 issue, "National Marine Sanctuaries Act: sanctuary resources," to evaluate the potential effects of continued nuclear power plant operation and any refurbishment during the license renewal term on sanctuary resources protected under the National Marine Sanctuaries Act.

Under the National Marine Sanctuaries Act, the National Oceanic and Atmospheric Administration Office of National Marine Sanctuaries designates and manages the National

Marine Sanctuary System. Marine sanctuaries may occur near nuclear power plants located on or near marine waters as well as the Great Lakes.

Section 3.8.3 and 3.8.6 of this EIS find that no National Marine Sanctuaries occur within the affected area. Accordingly, the NRC staff concluded that the proposed action would have no effect on sanctuary resources. Therefore, the environmental issue of National Marine Sanctuaries Act: sanctuary resources is addressed in this EIS.

G.7 Severe Accidents

With respect to postulated accidents, the draft rule proposes to amend Table B-1 in Appendix B to Subpart A of 10 CFR Part 51 (TN250) by reclassifying the Category 2 “Severe accidents” issue as a Category 1 issue. In the 2013 LR GEIS, the issue of severe accidents was classified as a Category 2 issue only to the extent that alternatives to mitigate severe accidents must be considered for nuclear power plants where the licensee had not previously performed a severe accident mitigation alternatives (SAMA) analysis for the plant. In the 2023 LR GEIS, the NRC notes that this issue will be resolved generically for the vast majority, if not all, expected license renewal applicants because the applicants who will likely reference the LR GEIS have previously completed a SAMA analysis.

As discussed in Appendix F of this EIS, an analysis of SAMAs was performed for North Anna and evaluated by the NRC staff at the time of initial license renewal (NRC 2002-TN8296). In Section 3.11.6.9 and Appendix F of this EIS, the NRC staff evaluated the significance of new information related to the plant-specific SAMA analysis. Therefore, the environmental issue of severe accidents is addressed in this EIS.

G.8 Greenhouse Gas Impacts on Climate Change

With respect to greenhouse gas (GHG) emissions and climate change, the draft rule proposes to amend Table B-1 in Appendix B to Subpart A of 10 CFR Part 51 (TN250) by adding a new Category 1 issue “Greenhouse gas impacts on climate change.” This new issue has an impact level of SMALL. This new issue considers GHG impacts on climate change from routine operations of nuclear power plants and construction vehicles and other motorized equipment for refurbishment activities. GHG emissions from routine operations of nuclear power plants are typically very minor, because such plants, by their very nature, do not normally combust fossil fuels to generate electricity. However, nuclear power plant operations do have some GHG emission sources, including diesel generators, pumps, diesel engines, boilers, refrigeration systems, and electrical transmission and distribution systems, as well as mobile sources (e.g., worker vehicles and delivery vehicles). GHG emissions from construction vehicles and other motorized equipment for refurbishment activities would be intermittent and temporary, restricted to the refurbishment period. GHG emissions from continued operations and refurbishment activities are minor.

The issue of GHG impacts on climate change associated with nuclear power plant operations was not identified as either a generic or plant-specific issue in the 1996 LR GEIS or the 2013 LR GEIS. In the 2013 LR GEIS, however, the NRC staff presented GHG emission factors associated with the nuclear power life cycle. Following the issuance of CLI-09-21 (NRC 2009-TN6406), the NRC began to evaluate the effects of GHG emissions in plant-specific environmental reviews for license renewal applications. Accordingly, Section 3.13 of this EIS) evaluates GHG emissions associated with the operation of North Anna during the SLR term. Table 3-1 of this EIS presents quantified annual GHG emissions from sources at North Anna for the 2017–2022 time period when GHGs were emitted from North Anna operations directly and indirectly. North Anna's direct GHG emissions result from stationary portable combustion sources, fire suppression system, electrical breakers, and refrigerant used for equipment onsite refrigeration appliances.

Dominion has no plans to conduct major refurbishment during the North Anna SLR term; therefore, no GHG emissions from refurbishment or increases in GHG emissions from routine operations at North Anna are anticipated. The NRC staff concludes that there would be no impacts on climate change beyond the impacts discussed in the 2023 LR GEIS and in Table B-1 in Appendix B to Subpart A of 10 CFR Part 51 of the proposed rule (88 FR 13329-TN8601). Based on this information, the NRC staff concludes that GHG impacts on climate change for North Anna during the SLR term are SMALL. Therefore, the environmental issue of GHG impacts on climate change is addressed in this EIS.

G.9 Climate Change Impacts on Environmental Resources

With respect to climate change, the draft rule proposes to amend Table B-1 in Appendix B to Subpart A of 10 CFR Part 51 (TN250) by adding the new Category 2 issue "Climate change impacts on environmental resources." This new issue considers the additive effects of climate change on environmental resources that may also be directly affected by continued operations and refurbishment during the license renewal term. The effects of climate change can vary regionally and climate change information at the regional and local scale is necessary to assess trends and the impacts on the human environment for a specific location. The impacts of climate change on environmental resources during the license renewal term are location-specific and cannot be evaluated generically.

The issue of climate change impacts was not identified as either a generic or plant-specific issue in the 1996 LR GEIS or the 2013 LR GEIS. However, the 2013 LR GEIS described the environmental impacts that could occur on resources areas (e.g., land use, air quality, water resources, etc.) that may also be affected by license renewal. In plant-specific initial license renewal and SLR environmental reviews prepared since the development of the 2013 LR GEIS, the NRC staff has considered projected differences in climate changes in the United States and climate change impacts on the resource areas that could be incrementally affected by the proposed action as part of its cumulative impacts analysis. Accordingly, Section 3.14.3.2 of this EIS discusses the observed changes in climate and the potential future climate change across the Southeast region of the United States during the North Anna SLR term based on climate model simulations under future global GHG emissions scenarios. The NRC staff considered regional projected climate changes from numerous climate assessment reports, including the U.S. Global Change Research Program, the Intergovernmental Panel on Climate Change (IPCC), the EPA, and the National Oceanic and Atmospheric Administration (NOAA 2013-TN7424). Furthermore, in Section 3.14.3 of this EIS, the NRC staff evaluated the overlapping impacts from climate change on environmental resources (e.g., Air Quality, Water Resources) where there are incremental impacts due to North Anna SLR. Therefore, this issue, "Climate change impacts on environmental resources," has been addressed in this EIS.

G.10 References

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NRC FORM 335 (12-2010) NRCMD 3.7 U.S. NUCLEAR REGULATORY COMMISSION **BIBLIOGRAPHIC DATA SHEET** *(See instructions on the reverse)*	1. REPORT NUMBER (Assigned by NRC, Add Vol., Supp., Rev., and Addendum Numbers, if any.) NUREG-1437 Supplemental 7a Second Renewal
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10. SUPPLEMENTARY NOTES

11. ABSTRACT (200 words or less)

The U.S. Nuclear Regulatory Commission (NRC) has prepared this site-specific environmental impact statement (EIS) as part of its environmental review of Dominion Energy Virginia's (Dominion) application for subsequent renewal of the operating licenses for North Anna Power Station, Units 1 and 2 (North Anna) for an additional 20 years. This EIS includes the site-specific evaluation of the environmental impacts of the proposed action (North Anna subsequent license renewal (SLR)), and alternatives to SLR. As alternatives, the NRC considered (1) new nuclear (small modular reactor) generation, (2) a combination of solar photovoltaic, offshore wind, small modular reactor, and demand side management, and (3) no action. Based on the NRC staff's site-specific evaluation of environmental impacts, the staff's preliminary recommendation is that the adverse environmental impacts of North Anna SLR are not so great that preserving the option of SLR for energy-planning decision-makers would be unreasonable. The NRC staff based its preliminary recommendation on the following: (1) Dominion's environmental report, as supplemented, (2) the NRC staff's consultations with Federal, State, Tribal, and local agencies, (3) the NRC staff's independent environmental review, and (4) consideration of public comments received during two scoping periods and comments received on the draft supplemental environmental impact statement.

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Site-Specific Environmental Impact Statement for License Renewal of Nuclear Plants Supplement 7a, Second Renewal, Regarding Subsequent License Renewal for North Anna Power Station Units 1 and 2

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